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Conservative Treatment of Acute and Chronic Nonspecific Low Back Pain

A Systematic Review of Randomized Controlled Trials of the Most Common Interventions

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Study Design. A systematic review of randomized controlled trials.

Objectives. To assess the effectiveness of the most common conservative types of treatment for patients with acute and chronic nonspecific low back pain.

Summary of Background Data. Many treatment options for acute and chronic low back pain are available, but little is known about the optimal treatment strategy.

Methods. A rating system was used to assess the strength of the evidence, based on the methodologic quality of the randomized controlled trials, the relevance of the outcome measures, and the consistency of the results.

Results. The number of randomized controlled trials identified varied widely with regard to the interventions involved. The scores ranged from 20 to 79 points for acute low back pain and from 19 to 79 points for chronic low back pain on a 100-point scale, indicating the overall poor quality of the trials. Overall, only 28 (35%) randomized controlled trials on acute low back pain and 20 (25%) on chronic low back pain had a methodologic score of 50 or more points, and were considered to be of high quality. Various methodologic flaws were identified. Strong evidence was found for the effectiveness of muscle relaxants and nonsteroidal anti-inflammatory drugs and the ineffectiveness of exercise therapy for acute low back pain; strong evidence also was found for the effectiveness of manipulation, back schools, and exercise therapy for chronic low back pain, especially for short-term effects.

Conclusions. The quality of the design, execution, and reporting of randomized controlled trials should be improved, to establish strong evidence for the effectiveness of the various therapeutic interventions for acute and chronic low back pain. [Key words: conservative treatment, low back pain, methodology, randomized controlled trials, systematic review] **Spine 1997;22:2128–2156**

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Low back pain (LBP) causes major medical and economical problems in Western industrialized countries, which is demonstrated by the high direct and indirect costs[151] and the large variety of therapeutic interventions available for its treatment.[152] The effectiveness of most of these interventions, however, has not yet been demonstrated beyond doubt. One of the major challenges for researchers in the field of LBP is to provide evidence of which treatment, if any, is the most optimal for (subgroups of) patients with LBP.

In 1987, the Quebec Task Force (QTF) on Spinal Disorders published management guidelines for activity-related spinal disorders on the basis of the strength of the scientific evidence.[139] The QTF regarded the randomized controlled trial (RCT) to be the strongest scientific proof of the effectiveness of an intervention. However, not only the type of study but also the methodologic quality of the study was assessed in the review process. Approximately 18% of the 469 studies selected by the QTF were RCTs, of which approximately 56% were considered to be of good or very good methodologic quality. According to the QTF, only bed rest for less than 2 days and back school were demonstrated by sound RCTs to be effective in the treatment of acute LBP for subjects not at work. No single therapeutic intervention was demonstrated to be effective in the treatment of chronic LBP. Since the publication of the report of the QTF, several other attempts have been made in the United States and the United Kingdom to incorporate the available scientific evidence about the most optimal LBP treatment strategy into clinical guidelines.[15,133]

The current interest in evidence-based medicine has led to an extensive increase in the publication of systematic reviews. Recently, several systematic reviews of RCTs on the effectiveness of various therapeutic interventions available for the treatment of LBP, such as bed rest, orthoses, exercise therapy, back schools, and spinal manipulation have been published by our research group.[78,79,84,85] However, most of these systematic reviews gave a summary of the literature on the effectiveness of one therapeutic intervention only, were based on literature published before 1992, and did not evaluate

the scientific evidence for acute and chronic LBP separately. Therefore, we decided to systematically review the scientific literature, to analyze the effectiveness of the most common conservative treatment options for acute and chronic nonspecific LBP.

Because the RCT is generally accepted as the paradigm of intervention research, we have restricted ourselves to the outcomes of RCTs. Because even RCTs may show biased outcomes, we also assessed the methodologic quality of the RCTs. Previously published reviews[78,79,84,85] about the effectiveness of bed rest and orthoses, exercise therapy, back schools, and spinal manipulation were updated, and we also included RCTs that evaluated the effectiveness of analgesics, nonsteroidal anti-inflammatory drugs (NSAIDs), muscle relaxants, antidepressants, epidural steroid injections, transcutaneous electrical nerve stimulation (TENS), traction, behavior therapy, orthoses, electromyographic biofeedback, and acupuncture.

Materials and Methods

Selection of Studies. A search was made of the MEDLINE database from 1966 through September 1995, the EMBASE drugs and pharmacology database from 1980 through September 1995, and the PsycLIT database from 1984 through September 1995, using Medical Subject Headings and free text words. The keywords used were: low back pain, backache, musculoskeletal diseases, joint diseases, spinal diseases, and physical therapy, and also the names of specific interventions. Subsequently, the references given in relevant identified publications were further examined. We reviewed the titles and abstracts of the identified articles, to determine the potential relevancy of the articles for our systematic review. If there was any doubt, the article was retrieved and read. Abstracts and unpublished studies were not selected. A study was included if:

1) it concerned a true randomized trial; trials with quasi-random procedures such as alternate allocation or allocation based on dates of birth were excluded;
2) the treatment regimen included one of the aforementioned therapeutic interventions;
3) the results, exclusively or separately, concerned patients with acute or chronic LBP;
4) the article was published in English.

Acute LBP was defined as LBP persisting for 6 weeks or less, and chronic LBP as LBP persisting for 12 weeks or more. Studies also were included if they reported on a mix of acute and subacute (6–12 weeks) or a mix of patients with subacute and chronic LBP. Studies were excluded if they reported on cervical back pain or a mix of thoracolumbar and cervical back pain, unless the results for thoracolumbar LBP were presented separately. Studies also were excluded if the study population consisted of postoperative patients.

Methodologic Quality of the Studies. All trials were scored according to the criteria listed in Table 1. The criteria are based on generally accepted principles of intervention research and refer to various aspects of study population, interventions, effect, and data presentation and analysis. The same criteria list was used in our previously published systematic reviews.[78,79,84,85] Each criterion was weighted, resulting in a maximum score of 100 points for each study. The methodologic quality of the RCTs was assessed by two independent reviewers. Disagreements between the two reviewers were resolved by consensus or by consulting a third researcher, who acted as referee. The assessments resulted in a hierarchical list in which higher scores indicate studies with a higher methodologic quality. We used the original scores of our previously published systematic reviews, which were assessed by several different reviewers.[78,79,84,85] All additional RCTs were assessed by the same two reviewers (BWK and MWvT).

Table 1. Criteria List* for the Methodologic Assessment of Randomized Controlled Trials of Therapeutic Interventions for Low Back Pain

Study population	
A	Homogeneity
B	Comparability of relevant baseline characteristics
C	Randomization procedure adequate
D	Drop-outs described for each study group separately
E	<20% loss to follow-up
	<10% loss to follow-up
F	>50 subjects in the smallest group
	>100 subjects in the smallest group
Interventions	
G	Interventions standardized and described
H	Pragmatic study/control group adequate†
I	Cointerventions avoided
J	Placebo controlled
Effect	
K	Patients blinded‡
L	Outcome measures relevant
M	Blinded outcome assessment
N	Follow-up period adequate
Data presentation and analysis	
O	Intention-to-treat analysis
P	Frequencies of most important outcomes presented for each treatment group.
Only trials of drug therapy	
Q	Compliance measured and satisfactory in all study groups

* The operationalization of the criteria has been published in our previous systematic review.[42–45]
† Criterion H was defined as "pragmatic study" for RCTs of drug therapies, for which a placebo treatment was feasible; criterion H was defined as "control group adequate" for RCTs of the other therapeutic interventions.
‡ Criterion K was not assessed for trials on the efficacy of bed rest.

Outcome of the Studies. We extracted the main results from each study according to what we consider to be the most important outcome measures (*i.e.*, pain intensity, overall improvement, and functional status). We considered a study to be positive if the therapeutic intervention involved was more effective than the reference treatment(s) with regard to at least one of these outcome measures. A study was considered to be negative if there were no differences between the intervention under study and the reference treatment on these outcome measures or if the reference treatment was more effective with regard to at least one of these outcome measures. If the therapeutic intervention under study was more effective on one of the outcome measures, but less effective on another, or if these outcome measures were not assessed in a study, no conclusion was drawn (category "no conclusion" in Tables 2–5).

Table 2. Randomized Controlled Trials on the Effectiveness of Drug Therapy in Acute Low Back Pain in Order of Methodologic Score

	Scores for Methodologic Criteria																		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	Total Score	
Reference	2	5	4	3	4	12	10	5	5	5	9	8	8	5	5	5	5	100	Conclusion*
Analgesics																			
Videman[154]	1	3	—	2	4	—	8	5	—	—	5	7	7	3	—	5	—	50	Negative
Wiesel[160]	2	3	—	3	4	—	6	5	5	—	—	4	—	3	5	5	—	45	Positive
Brown[23]	2	1	—	—	2	—	10	5	5	—	—	7	1	3	—	5	—	41	Negative
Evans[42]	1	1	—	—	4	—	10	5	5	—	—	5	1	3	—	—	—	35	Negative
Hackett[56]	1	2	—	3	4	—	—	5	—	5	5	3	3	3	—	—	—	34	Negative
Nwuga[122]	2	4	—	—	—	—	5	5	—	—	—	4	1	3	—	5	—	29	Negative
Nonsteroidal anti-inflammatory drugs (NSAIDs)																			
Hosie[68]	2	5	—	2	4	12	10	5	5	—	5	8	8	3	5	5	—	79	Negative
Amlie[5]	2	4	—	2	4	12	10	—	5	5	5	7	7	3	—	5	—	71	Positive
Goldie[53]	2	4	4	3	4	—	10	—	5	5	5	5	5	3	5	5	—	65	Negative
Weber[158]	2	3	—	—	4	6	10	—	5	5	5	6	6	3	—	5	5	65	Negative
Bakshi[9]	2	4	—	2	2	6	10	5	—	—	5	7	7	3	5	5	—	63	Negative
Blazek[16]	2	3	—	3	4	—	10	5	5	—	5	6	6	3	5	5	—	62	Negative
Szpalski[144]	2	4	—	1	4	—	10	—	5	5	5	6	6	3	—	5	—	56	Positive
Lacey[87]	—	3	—	1	2	12	10	—	—	5	5	6	6	3	—	—	—	53	Positive subgroup
Videman[154]	1	3	—	2	4	—	10	5	—	—	5	7	7	3	—	5	—	52	Negative
Sweetman[143]	2	4	—	—	2	—	8	5	—	—	5	8	8	3	—	5	—	50	Negative
Orava[125]	2	5	—	1	4	6	10	5	—	—	—	8	—	3	—	5	—	49	Negative
Wiesel[160]	2	3	—	3	4	—	8	5	5	—	—	4	—	3	5	5	—	47	Negative
Agrifoglio[2]	1	3	—	2	2	—	10	5	—	—	5	5	5	3	—	5	—	46	Positive
Weber[157]	2	2	—	—	—	—	10	—	—	5	5	6	6	3	—	5	—	44	Positive
Waterworth[156]	2	2	—	2	4	—	10	5	5	—	—	8	—	3	—	—	—	41	Negative
Brown[23]	2	1	—	—	2	—	10	5	5	—	—	7	1	3	—	5	—	41	Negative
Evans[42]	1	1	—	—	4	—	10	5	5	—	—	5	1	3	—	—	—	35	Positive
Aghababian[1]	2	3	—	1	—	—	10	5	—	—	—	6	—	3	—	5	—	35	Positive
Postacchini[127]	2	—	—	—	2	—	8	5	—	—	—	5	—	5	—	—	—	27	Not clear
Muscle relaxants																			
Berry[14]	1	3	—	3	4	6	8	5	5	5	5	4	4	3	5	5	—	66	Positive
Baratta[10]	—	3	4	—	4	6	8	—	—	5	5	8	8	3	5	5	—	64	Positive
Casale[27]	1	4	4	—	4	—	8	—	5	5	5	3	3	3	5	5	—	55	Positive
Boyles[21]	2	3	4	3	2	—	8	5	5	—	5	7	7	3	—	—	—	54	Positive
Hindle[66]	—	2	4	3	2	—	8	5	—	5	5	8	8	3	—	—	—	53	Positive
Middleton[114]	2	3	—	—	4	6	8	5	5	—	—	7	—	3	5	5	—	53	Negative
Dapas[30]	1	3	—	—	—	6	8	—	5	5	5	8	8	3	—	—	—	52	Positive
Rollings[132]	2	3	4	3	—	—	8	5	5	—	5	7	7	3	—	—	—	52	Negative
Berry[13]	1	3	—	3	2	6	8	—	—	5	5	4	4	3	—	5	—	49	Positive
Gold[52]	—	1	—	—	4	—	8	5	—	5	5	4	4	3	5	—	—	44	Positive
Sweetman[143]	1	1	—	3	—	—	8	5	—	—	5	5	5	3	—	5	—	43	Positive
Borenstein[20]	1	2	—	—	4	—	8	5	5	—	—	7	—	3	5	—	—	40	Positive
Hingorani[67]	—	—	—	—	4	—	8	—	—	5	5	2	2	3	5	5	—	39	Negative
Tervo[145]	—	3	4	—	—	—	8	—	—	—	5	2	2	3	—	—	—	27	Positive
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P		Total	
	2	5	4	3	4	17	10	5	5	5	5	10	10	5	5	5		100	
Epidural steroid injections																			
Mathews[106]	1	3	4	3	4	—	10	—	5	5	3	4	4	5	5	5		61	Positive

* Positive if the therapeutic intervention involved was more effective than the reference treatment(s) with regard to pain intensity, overall improvement, or functional status; negative if there was no difference between the intervention and the reference treatment(s) on these outcome measures or if the reference treatment was more effective.

Levels of Evidence. Our conclusions on the effectiveness of the therapeutic interventions were based on the strength of the scientific evidence. For this purpose, we used a rating system based on the one used in the U.S. Clinical Practice Guideline for Acute Low Back Problems in Adults.[15] The rating system consisted of four levels of scientific evidence based on the quality and the outcome of the studies:

1) Strong evidence—multiple relevant, high quality RCTs.
2) Moderate evidence—one relevant, high quality RCT and one or more relevant, low quality RCTs.
3) Limited evidence—one relevant, high quality RCT or multiple relevant, low quality RCTs.
4) No evidence—only one relevant, low quality RCT, no relevant RCTs or contradictory outcomes.

An RCT was regarded as relevant if at least one of the outcome measures concerned pain intensity, overall improvement, or functional status. An RCT was (arbitrarily) considered to be of high quality if the methodologic score was 50 points or more, and of low quality if the methodologic score was less than 50 points.

Table 3. Randomized Controlled Trials on the Effectiveness of Other Conservative Treatments for Acute Low Back Pain in Order of Methodologic Score

	Scores for Methodologic Criteria																	
	A	B	C	D	E	F	G	H	I	J		L	M	N	O	P	Total Score	
Reference	2	5	4	3	4	17	10	5	5	5		10	15	5	5	5	100	Conclusion*
Bed rest																		
Deyo[33]	2	5	4	—	4	17	10	5	5	—		10	6	—	5	—	73	Negative
Gilbert[40,49]	2	5	2	—	2	8	10	5	—	5		6	3	5	—	5	58	Negative
Malmivaara[99]	1	5	4	—	2	8	5	5	—	5		10	3	—	—	5	53	Negative
Wilkinson[161]	2	5	2	—	—	—	10	5	5	5		6	—	—	—	5	45	Negative
Postacchini[127]	2	3	—	—	2	—	5	5	—	—		6	—	5	—	—	28	Negative
Wiesel[160]	2	3	—	—	4	—	—	—	5	—		4	—	—	5	—	23	Positive
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Total	
	2	5	4	3	4	17	10	5	5	5	5	10	10	5	5	5	100	
Exercise therapy																		
Faas[43,44]	2	5	4	—	2	17	10	5	5	5	3	6	—	5	—	5	74	Negative
Evans[40,49]	2	5	—	—	—	8	10	5	—	—	—	10	2	5	—	5	52	Negative
Malmivaara[99]	1	5	4	—	2	8	5	5	—	—	—	10	2	—	—	5	47	Negative
Stankovic[140,141]	1	3	4	3	4	—	10	5	—	—	—	2	—	5	5	5	47	Positive
Waterworth[156]	2	5	—	3	4	—	5	5	5	—	—	6	—	3	5	—	43	Negative
Nwuga[121]	2	4	2	—	—	—	10	5	—	—	3	2	2	3	—	5	38	Negative
Farrell[45]	2	5	—	—	2	—	10	5	—	—	—	8	2	3	—	—	37	Negative
Davies[31]	2	3	—	—	4	—	—	5	—	—	3	6	2	3	—	5	33	Negative
Delitto[32]	1	2	2	—	—	—	10	5	—	—	—	2	—	3	—	5	30	Positive
Nwuga[123]	2	2	2	—	—	—	—	5	—	—	3		2	3	—	5	28	Positive
Back schools																		
Bergquist[11]	2	3	2	—	2	8	10	5	—	—	—	4	—	5	—	5	46	Positive
Stankovic[140,141]	2	3	4	—	4	—	10	—	—	—	—	6	—	5	5	—	39	Negative
Lindequist[93]	1	2	—	—	4	—	5	5	—	—	—	4	—	5	5	5	36	Negative
Morrison[117]	—	—	—	—	—	8	—	—	—	—	—	4	—	5	—	5	22	Positive
Manipulation																		
MacDonald[98]	1	4	—	3	4	—	10	5	5	—	—	6	—	3	5	5	51	Overall negative; positive subgroup only
Sanders[135]	—	2	2	3	4	—	10	5	5	5	3	2	2	3	5	—	51	Not clinically relevant
Hadler[57]	1	3	—	—	4	—	10	5	5	—	3	4	—	3	5	5	48	Positive subgroup
Bergquist[11]	2	1	2	—	4	8	10	5	—	5	2	2	—	5	—	—	46	Positive vs. placebo; negative vs. back school
Mathews[107]	—	2	—	3	2	17	5	5	—	—	—	2	—	5	—	5	46	Positive subgroup
Helliwell[62]	1	3	—	3	4	—	5	5	5	—	—	2	2	3	5	5	43	Negative
Glover[50]	—	3	4	3	4	—	5	—	5	5	—	2	—	3	5	—	39	Negative
Blomberg[17–19]	1	2	4	—	4	—	—	5	—	—	—	6	2	3	5	5	37	Positive
Rasmussen[128]	1	1	—	—	4	—	—	5	5	—	—	4	—	3	5	5	33	Positive
Delitto[32]	—	1	2	—	4	—	10	5	—	—	—	2	—	3	—	5	32	Positive
Farrell[45]	2	4	—	—	2	—	—	5	5	—	—	6	—	3	—	5	32	Positive
Nwuga[121]	2	3	—	—	—	—	10	5	5	—	—	2	2	3	—	—	32	Positive
Waterworth[156]	2	3	—	3	4	—	—	5	5	—	—	6	—	3	—	—	31	Negative
Postacchini[127]	—	2	—	—	2	—	—	5	5	5	—	4	—	5	—	—	28	Positive
Wreje[163]	1	2	—	—	2	—	10	—	—	5	—	2	—	3	—	—	25	Positive
Godfrey[51]	1	1	—	—	2	—	—	5	—	—	—	8	2	3	—	—	22	Negative
Transcutaneous electrical nerve stimulation (TENS)																		
Herman[63]	1	3	4	3	—	—	10	—	5	5	3	6	6	5	—	5	56	Negative
Hackett[56]	1	2	—	3	4	—	—	5	—	5	3	4	4	3	5	—	39	Positive
Traction																		
Larsson[89]	2	4	—	3	4	—	10	5	—	—	—	2	—	3	5	5	43	Positive
Mathews[105]	—	2	—	3	2	8	5	5	—	—	—	2	—	3	—	5	35	Positive subgroup
Behavior therapy																		
Fordyce[46]	2	4	—	—	—	—	—	5	—	—	—	4	—	5	—	—	20	Positive

* Positive if the therapeutic intervention involved was more effective than the reference treatment(s) with regard to pain intensity, overall improvement, or functional status; negative if there was no difference between the intervention and the reference treatment(s) on these outcome measures or if the reference treatment was more effective.

Results

Methodologic Quality of the Studies

A total of 150 articles met our inclusion criteria, 68 that evaluated treatment of acute LBP, 81 chronic LBP, and 1 acute and chronic LBP. The number of RCTs identified varied widely with regard to the interventions involved (Tables 2–5). Overall, only 28 RCTs (34.6%) that studied acute LBP and 20 RCTs (25%) that studied chronic LBP had a methodologic score of 50 points or more and

Table 4. Randomized Controlled Trials on the Effectiveness of Drug Therapy in Chronic Low Back Pain in Order of Methodologic Score

	Scores for Methodologic Criteria																		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	Total Score	
Reference	2	5	4	3	4	12	10	5	5	5	9	8	8	5	5	5	5	100	Conclusion*
Analgesics																			
Hickey[65]	2	1	4	2	4	—	10	5	5	—	5	8	8	3	—	5	—	62	Negative
Muscle relaxants																			
Arbus[6]	1	—	—	3	2	—	10	—	—	5	5	6	6	3	—	5	5	51	Positive
Antidepressants																			
Goodkin[54]	1	4	—	3	4	—	10	—	—	5	7	6	6	3	5	5	5	64	Negative
Alcoff[3]	—	4	—	3	2	—	10	—	—	5	5	6	6	3	5	—	—	49	Positive
Jenkins[71]	1	2	—	—	—	—	10	—	—	5	5	5	5	3	—	—	—	36	Negative
Pheasant[126]	1	—	—	—	—	—	10	—	—	5	5	3	3	3	—	5	—	35	No conclusion
NSAIDs																			
Hickey[65]	2	1	4	2	4	—	10	5	5	—	5	8	8	3	—	5	—	62	Positive
Siegmeth[138]	—	—	—	2	4	—	10	5	5	—	—	8	8	3	—	5	—	50	No conclusion
Videman[153]	1	3	—	2	4	—	10	5	—	—	5	6	6		—	5	—	50	Positive
Berry[12]	2	—	—	2	4	—	10	5	5	5	5	4	4	3	—	—	—	49	Positive
Matsumo[108]	1	—	—	—	4	6	8	5	5	—	5	3	1	3	—	5	—	46	Negative
Postacchini[127]	2	—	—	—	2	—	8	5	—	—	—	5	—	5	—	—	—	27	No conclusion
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P			
	2	5	4	3	4	17	10	5	5	5	5	10	10	5	5	5			
Epidural steroid injections																			
Breivik[22]	1	2	4	3	4	—	10	—	5	5	3	6	6	—	5	5		59	Positive
Bush[25]	2	3	—	3	2	—	10	—	—	5	3	6	6	5	5	5		55	Positive
Cuckler[29]	2	4	4	3	4	—	10	—	—	5	3	2	2	5	5	5		54	Negative
Serrao[137]	2	4	—	3	4	—	10	—	—	—	3	6	6	3	5	5		51	Negative
Rocco[131]	1	3	4	—	4	—	10	—	—	—	3	4	4	5	—	5		43	Negative
Ridley[129]	2	4	2	—	2	—	10	—	—	5	3	4	4	5	—	—		41	Positive short-term only

* Positive if the therapeutic intervention involved was more effective than the reference treatment(s) with regard to pain intensity, overall improvement, or functional status; negative if there was no difference between the intervention and the reference treatment(s) on these outcome measures or if the reference treatment was more effective.

were considered to be of high quality, indicating the overall poor quality of the RCTs. The methodologic scores ranged from 20 to 79 points for acute LBP and 19 to 79 points for chronic LBP. In general, the methodologic quality of the drug therapy trials was somewhat higher than the methodologic quality of the RCTs that studied the other conservative types of treatment. Tables 2 and 4 show the methodologic quality of the RCTs concerning various drug therapies for acute and chronic LBP, respectively. Twenty (50%) of the 40 RCTs that studied drug therapy for acute LBP scored 50 points or more; the median score was 50, with a range of 27 to 79. Ten (56%) of the 18 RCTs that studied drug therapy for chronic LBP scored 50 points or more; the median score was 50, with a range of 27 to 64. Tables 3 and 5 show the methodologic quality of the RCTs that studied the other types of treatment for acute and chronic LBP, respectively. Eight (19.5%) of the 41 RCTs that studied acute LBP scored 50 points or more, the median score being 38.5 and the range 20 to 74. Ten (16%) of the 62 RCTs that studied chronic LBP scored 50 points or more, the median score being 37 and the range 19 to 79.

Effectiveness of the Therapeutic Interventions for Acute Low Back Pain

Analgesics. Six RCTs were identified, of which only one was considered to be of high methodologic quality.[154] There is moderate evidence (level 2) that analgesics are not more effective than NSAIDs, and no evidence that analgesics are more effective than electroacupuncture or ultrasound for acute LBP (level 4).

Nonsteroidal Anti-Inflammatory Drugs. Nineteen RCTs were identified, of which ten were considered to be of high quality[5,9,16,53,68,87,143,144,154,158] and nine of low quality.[1,2,23,42,125,127,156,157,160] Five of the ten high quality RCTs compared NSAIDs with a placebo. Three of these RCTs reported a positive outcome for uncomplicated LBP,[5,87,144] but only for one of the follow-up moments or for a subgroup only. The two negative high quality RCTs[53,158] compared NSAIDs with a placebo for patients with acute LBP with sciatica or acute sciatica with nerve root symptoms. The high quality RCT[154] comparing an NSAID to an analgesic did not show a difference in improvement of pain intensity. The three high quality RCTs comparing different types of NSAIDs[9,16,68] also did not report any differences. There is strong evidence (level 1) that NSAIDs are more effective than a placebo in patients with uncomplicated acute LBP, but not in patients with acute sciatica. There is strong evidence (level 1) that NSAIDs are not more effective than analgesics, and that the various types of NSAIDs, piroxicam, ibuprofen, diclofenac, felbinac, and biarison, are equally effective for acute LBP.

Table 5. Randomized Controlled Trials on the Effectiveness of Other Conservative Treatments in Chronic Low Back Pain in Order of Methodologic Score

Reference	Scores for Methodologic Criteria																Total Score	Conclusion*
	A 2	B 5	C 4	D 3	E 4	F 17	G 10	H 5	I 5	J 5	K 5	L 10	M 10	N 5	O 5	P 5	100	
Manipulation																		
Koes[80–83]	1	3	4	3	—	8	—	5	—	5	3	8	4	3	5	5	57	Positive
Ongley[124]	2	4	2	—	4	—	5	5	—	—	5	4	4	5	5	5	50	Positive
Triano[146]	1	1	4	—	—	8	5	5	—	5	2	4	—	3	—	5	43	Positive
Gibson[48]	2	3	—	3	4	—	—	5	5	5	—	4	2	3	—	5	41	Negative
Herzog[64]	—	1	—	—	—	—	10	5	5	—	—	6	2	3	—	5	37	No conclusion
Evans[41]	—	—	2	—	2	—	5	5	5	—	—	6	2	3	—	5	35	Positive
Waagen[155]	1	2	—	—	—	—	5	5	5	—	5	4	2	3	—	—	32	Positive
Arkuszewski[7]	—	1	2	—	4	—	—	5	—	—	—	4	—	5	5	5	31	Positive
Postacchini[127]	1	3	—	—	2	—	5	5	—	—	—	6	—	5	—	—	27	Negative
Back schools																		
Harkapaa[59,60,110,111]	1	3	—	—	4	17	10	5	—	5	—	10	—	5	5	5	70	Positive
Hurri[69,70,73]	2	3	—	—	4	8	10	5	—	—	—	8	—	5	5	5	55	Positive
Linton[96]	1	1	—	3	4	—	10	5	—	—	—	6	—	5	5	5	45	Positive
Lankhorst[88]	2	3	2	—	2	—	5	5	—	—	3	6	—	5	—	5	38	Negative
Keijsers[75]	1	—	—	3	2	—	—	5	—	—	—	8	—	5	—	5	29	Negative
Donchin[37]	—	3	—	—	—	—	5	5	—	—	—	4	—	5	5	—	27	Negative
Postacchini[127]	1	3	—	—	2	—	5	5	—	—	—	6	—	5	—	—	27	Positive
Herzog[64]	1	1	—	—	—	—	—	5	—	—	—	6	2	3	—	5	23	No conclusion
Klaber[77]	1	3	—	—	2	—	5	5	—	—	—	4	—	3	—	—	23	Positive
Keijsers[74]	1	1	—	—	—	—	5	5	—	—	—	4	—	3	—	—	19	No conclusion
EMG biofeedback																		
Asfour[8]	1	3	—	—	4	—	10	5	—	—	—	4	—	3	5	5	40	Negative
Bush[24]	1	4	—	—	4	—	10	—	—	5	3	4	—	3	5	—	39	Negative
Nouwen[120]	1	2	—	3	4	—	10	—	—	—	—	2	—	3	5	5	35	Negative
Stuckey[142]	1	—	—	—	—	—	—	5	—	5	3	4	4	3	—	5	30	Negative
Donaldson[36]	1	—	—	—	—	—	5	5	—	—	—	4	—	3	—	5	23	Positive
Exercise therapy																		
Deyo[34]	1	3	4	3	2	8	10	5	—	—	—	10	2	3	5	5	61	Positive
Hansen[58]	1	4	2	3	—	8	10	5	—	5	3	4	4	5	—	5	59	Positive
Manniche[100,101]	2	1	4	3	2	—	10	5	—	—	—	10	2	5	5	5	54	Positive
Elnaggar[39]	1	3	2	3	4	—	10	5	—	—	—	4	2	3	5	5	47	Negative
Lidström[92]	1	2	—	3	4	—	10	5	—	—	—	6	2	3	5	5	46	Positive
Manniche[102]	1	3	2	3	—	—	10	5	—	—	—	8	2	5	—	5	44	Negative
Lindström[94,95]	2	2	—	—	4	8	5	5	—	—	—	4	—	2	5	5	42	Positive
Johanssen[72]	1	2	—	3	—	—	10	5	—	—	—	10	—	5	—	5	41	Negative
Turner[149]	1	1	—	—	—	—	10	5	—	—	—	8	2	5	—	5	37	Negative
Kendall[76]	1	—	2	—	2	—	10	5	—	—	—	6	2	3	—	5	36	Positive
Risch[130]	—	3	2	—	4	—	5	5	—	—	—	4	—	3	5	5	36	Positive
Martin[104]	2	—	2	—	—	—	10	5	—	5	—	6	2	3	—	—	35	Negative
Buswell[26]	—	1	—	—	—	—	10	5	—	—	—	4	—	5	5	—	30	Negative
Sachs[134]	—	1	—	—	4	—	10	5	—	—	—	2	—	3	5	—	30	Negative
Frost[47]	2	4	2	—	—	—	—	5	—	—	—	6	—	5	—	5	29	Positive
White[159]	1	—	—	—	—	8	—	5	5	—	—	2	—	3	—	—	24	Negative
Traction																		
Heijden[61]	1	2	4	—	2	—	10	—	—	5	5	6	6	5	5	5	56	Positive
Orthoses																		
Million[115]	2	2	—	—	—	—	10	5	—	—	3	8	—	3	—	—	38	Positive
Behavior therapy																		
Lindström[94,95]	2	2	—	—	4	8	5	5	—	—	—	4	—	5	5	5	45	Positive
Turner[148]	1	1	—	—	4	—	10	5	—	—	—	8	—	5	5	5	44	Positive
Nicholas[119]	1	1	—	—	2	—	10	5	5	—	—	6	—	5	—	5	40	Positive
Nicholas[118]	1	1	—	—	—	—	10	5	5	—	—	6	—	5	—	5	38	Positive
Turner[147]	—	2	—	—	—	—	10	5	—	—	—	10	—	5	—	5	37	Positive
Turner[149]	1	1	—	—	—	—	10	5	—	—	—	8	2	5	—	5	37	Positive
Turner[150]	1	1	—	—	—	—	10	5	—	—	—	8	2	5	—	5	37	Positive
Altmaier[4]	1	2	—	—	2	—	10	5	—	—	—	6	—	5	—	5	36	Negative
Stuckey[142]	1	—	—	—	—	—	10	5	—	—	3	4	—	3	—	5	31	Positive
McCauley[109]	1	3	—	—	—	—	10	5	—	—	—	6	—	3	—	—	28	Negative
Donaldson[36]	1	—	—	—	—	—	5	5	—	—	—	4	—	5	—	5	25	Negative
Transcutaneous electrical nerve stimulation (TENS)																		
Deyo[34]	1	3	4	3	2	8	10	—	5	5	5	10	10	3	5	5	79	Negative
Marchand[103]	1	3	—	—	4	—	10	5	—	5	5	2	2	5	5	5	52	Positive short-term
Lehmann[90,91]	1	—	—	—	—	—	10	5	—	5	3	4	4	3	—	5	35	Negative
Acupuncture																		
Coan[28]	1	3	4	—	4	—	5	5	—	—	—	8	—	5	5	5	56	Positive
Mendelson[112,113]	1	3	—	—	—	—	10	—	—	5	3	6	6	3	—	5	42	Negative
MacDonald[97]	—	—	—	—	4	—	10	—	—	5	3	6	6	3	5	—	42	Positive
Edelist[38]	—	—	—	—	4	—	10	—	—	5	3	2	2	3	5	5	39	Negative
Lehmann[90,91]	1	—	—	—	—	—	10	5	—	5	3	4	4	3	—	—	35	Positive
Gunn[55]	1	2	2	—	—	—	5	5	—	—	—	2	—	5	—	5	27	Positive

* Positive if the therapeutic intervention involved was more effective than the reference treatment(s) with regard to pain intensity, overall improvement, or functional status; negative if there was no difference between the intervention and the reference treatment(s) on these outcome measures or if the reference treatment was more effective.

Muscle Relaxants. Eight high quality RCTs[10,14,21,27,30,66,114,132] and six low quality RCTs[13,20,52,67,143,145] were identified that studied the effectiveness of muscle relaxants. All five high quality RCTs comparing a muscle relaxant with a placebo[10,14,27,30,66] reported a better improvement in pain intensity for the muscle relaxant. The three high quality RCTs comparing different types of muscle relaxants[21,114,132] reported no differences with regard to pain intensity. There is strong evidence (level 1) that muscle relaxants are more effective than a placebo for acute LBP. There is also strong evidence (level 1) that different types of muscle relaxants are equally effective for acute LBP.

Epidural Steroid Injections. Only one high quality RCT[106] was identified, indicating that there is limited evidence on the effectiveness of epidural steroid injections for acute LBP with nerve root pain and radicular neurologic deficit (level 3).

Bed Rest. Six RCTs were identified, three of high quality[33,40,49,99] and three of low quality.[127,160,161] Five of the trials, including the three high quality RCTs, reported negative results. There is strong evidence (level 1) that bed rest is not an effective treatment option for acute LBP.

Exercise Therapy. Ten RCTs were identified, two high quality[40,43,44] and eight low quality RCTs.[31,32,45,99,121,123,140,141,156] Seven RCTs,[31,40,43–45,99,121,156] including the two of high quality, reported negative results, and three RCTs reported positive results.[32,123,140,141] There is strong evidence that exercise therapy is not more effective than other conservative treatments, including no intervention, for acute LBP (level 1).

Back Schools. Four low quality RCTs[11,93,117,140,141] were identified on the effectiveness of some type of back school. There is no evidence (level 4) that a back school is effective for acute LBP, because of the contradictory results.

Manipulation. Sixteen RCTs were identified, of which only two were of high quality[98,135] and 14 of low quality.[11,17,18,19,32,45,50, 51,57,62,107,121,127,128,156,163] Twelve trials, including the two high quality RCTs, reported positive results, and four trials[50,51,62,156] reported negative results. However, in one of the high quality trials,[135] a fatal flaw (a follow-up period of only 30 minutes after one single manipulation) was identified, and this trial was not included in our assessment of evidence. In four nonpragmatic trials, manipulation was compared with some type of placebo therapy.[11,50,127,163] Three of the four low quality RCTs[11,127,163] reported a positive result for manipulation compared with placebo. Fourteen pragmatic trials (one high quality RCT) were identified that compared manipulation with other conservative types of treatment.[11,17–19,32,45,51,57,62,98,121,127,128,135,156] In 10 of these RCTs, the results were positive, and in 4 RCTs,[51,62,98,156] including one high quality RCT,[98] the results were negative. There is limited evidence that manipulation is more effective than a placebo treatment for acute LBP (level 3). There is no evidence that manipulation is more effective than (other) physiotherapeutic applications (massage, shortwave diathermy, exercises) or drug therapy (analgesics, NSAIDs) for acute LBP, because of the contradictory results.

Transcutaneous Electrical Nerve Stimulation. Two trials studied the effectiveness of TENS, of which one was of high[63] and one of low quality.[56] There is no evidence (level 4) that TENS is an effective treatment for acute LBP, because of the contradictory results.

Traction. Only two low quality RCTs[89,105] were identified, which both reported a positive result. There is limited evidence (level 3) that traction is effective for acute LBP.

Behavior Therapy. Only one low quality RCT[46] was identified, indicating that there is no evidence (level 4) on the effectiveness of behavior therapy for acute LBP.

Effectiveness of the Therapeutic Interventions for Chronic Low Back Pain

Analgesics. Only one high quality RCT[65] was identified on the effectiveness of analgesics for chronic LBP, indicating that there is limited evidence that paracetamol is equally effective as diflunisal (NSAID) (level 3).

Muscle Relaxants. Because only one high quality RCT[6] was identified, there is limited evidence for the effectiveness of muscle relaxants for chronic LBP (level 3). This RCT reported a positive result of tetrazepam compared with a placebo.

Antidepressants. One high quality[54] and three low quality RCTs[3,71,126] were identified. All four RCTs compared an antidepressant with a placebo.[3,54,71,126] There is moderate evidence that antidepressants are not effective for chronic LBP (level 2).

Nonsteroidal Anti-Inflammatory Drugs. Six RCTs were identified, three high quality RCTs[65,138,153] and three low quality RCTs.[12,108,127] One low quality RCT compared two types of NSAIDs with a placebo in a crossover design and had a positive outcome.[12] Of the two pragmatic RCTs that compared NSAIDs with other conservative types of treatment, the high quality RCT reported a positive outcome, with overall improvement.[65,127] The results of the four RCTs that compared two different types of NSAIDs, two high quality and two low quality, were all negative.[12,108,138,153] There is moderate evidence (level 2) that NSAIDs are effective for chronic LBP, and there is strong evidence (level 1) that the various types of NSAIDs, piroxicam, indomethacin, ibuprofen, diclofenac, ketoprofen, naproxen, and diflunisal, are equally effective.

Epidural Steroid Injections. Four high quality[22,25,29,137] and two low quality RCTs[129,131] that studied epidural steroid injections were identified. Two of the six trials compared the epidural steroid injection with a placebo injection (saline).[22,129] Both trials, one high quality and one low quality, reported significantly better short-term results of pain relief from epidural steroid injection. Epidural steroid injection was also compared with an injection of bupivacaine,[22] procaine,[29] midazolam,[137] or lignocaine and morphine.[131] Three of these four trials were of high quality and one of low quality. There is moderate evidence that epidural steroid injections are more effective than a placebo in the short-term for chronic LBP (level 2). However, there is no evidence that epidural steroid injections are more effective than injections of a local anesthetic or a muscle relaxant for chronic LBP (level 4), because the results of these trials were contradictory.

Manipulation. Two high quality[80–83,124] and seven low quality RCTs[7,41,48,64,127,146,155] were identified. Six trials, including the two high quality RCTs, reported positive results, two trials reported negative results, and, in one trial, no clear conclusion was drawn (we considered this trial to be negative). In five nonpragmatic trials, manipulation was compared with a placebo therapy.[48,80–83,124,127,146] The two high quality RCTs reported a positive result for manipulation compared with a placebo.[80–83,124] Eight pragmatic trials (one high quality RCT) were identified that compared manipulation with other conservative types of treatment.[7,41,48,64,80–83,127,146,155] In five of these RCTs, including one high quality RCT, the results were positive, and in three RCTs, the results were negative. There is strong evidence that manipulation is more effective than a placebo treatment for chronic LBP (level 1). There is moderate evidence that manipulation is more effective for chronic LBP than usual care by the general practitioner, bed-rest, analgesics, and massage (level 2).

Back Schools. Ten RCTs, two of high quality[59,60,69,70,73,110,111] and eight of low quality,[37,64,74,75,77,88,96,127] were identified that studied the effectiveness of some type of back school. In two studies, no clear conclusion was drawn, but we considered one of these trials as positive[64] and one as negative.[74] In seven nonpragmatic trials, a back school was compared with no treatment, a waiting-list control group, and a placebo treatment.[37,59,60,69,70,73–75,88,96,110,111] The two nonpragmatic high quality RCTs reported positive outcomes of an intensive modified Swedish back school program compared with no actual treatment in an occupational setting.[59,60,69,70,73,110,111] Of the four pragmatic low quality trials, three reported positive[64,77,127] and one reported negative[37] results. There is strong evidence (level 1) that an intensive back school program in an occupational setting is more effective than no actual treatment for chronic LBP. There is limited evidence (level 3) that a back school is more effective than other conservative types of treatment for chronic LBP.

Electromyographic Biofeedback. Five low quality trials were identified that studied the effectiveness of electromyographic biofeedback.[8,24,36,120,142] The sample sizes of all study groups were very small, not exceeding 22 patients. Four RCTs reported negative results[8,24,120,142] and only one RCT reported a positive result.[36] There is limited evidence that electromyographic biofeedback is not effective for chronic LBP (level 3).

Exercise Therapy. Sixteen trials were identified, three high quality[34,58,100,101] and 13 low quality[26,39,47,72,76,92,94,95,102,104,130,134,149,159] RCTs. The number of RCTs that reported positive and negative results was equal (n = 8), but the three high quality RCTs all reported positive results. In nine trials, exercises were compared with various reference treatments, such as traditional care, physical therapy, hot packs and rest, behavioral therapy, no exercise, a waiting-list control group, or a placebo treatment.[34,47,58,92,94,95,104,130,134,149] Six of these nine trials, including two high quality RCTs, reported a positive result, whereas three low quality RCTs reported a negative result. The effectiveness of different types of exercises was examined in nine trials.[26,39,72,76,92,100–102,104,159] Six low quality trials reported a negative result and one high quality and two low quality trials reported a positive result. There is strong evidence that exercise therapy is effective for chronic LBP (level 1), and there is no evidence in favor of one of the exercises due to the contradictory results (level 4).

Traction. Only one high quality RCT[61] was identified that studied the effectiveness of traction in the treatment of chronic LBP.[61] Although the authors' conclusion was positive, no significant differences were found with regard to pain intensity and functional status. There is limited evidence that traction is not effective for chronic LBP (level 3).

Orthoses. Only one low quality RCT[115] was identified, indicating that there is no evidence (level 4) for the effectiveness of orthoses in the treatment of chronic LBP.

Behavior Therapy. Eleven low quality RCTs were identified that studied the effectiveness of behavior therapy for chronic LBP.[4,36,94,95,109,118,119,142,143,147–150,151] Eight of the 11 trials reported positive results for behavior therapy, and three trials reported negative results. The four trials by Turner et al[147–150,151] reported positive results of various kinds of behavior therapies compared with a waiting-list control group. In eight trials, behavior therapy was compared with other conservative types of treatment.[4,36,94,95,109,118,119,142,147] Five of these trials had positive results, and three had negative results. Five RCTs compared different types of behavior therapies (*i.e.*, operant conditioning, cognitive treatment [coping strategies], and progressive muscle relax-

ation).[118,147,148,150,151] Three trials reported negative results and two reported positive results for this comparison. There is limited evidence that behavior therapy is an effective treatment modality for chronic LBP with good short-term results (level 3). There is no evidence that one particular behavior therapy is more effective than the other behavior therapies (level 4), because the results of these trials were contradictory.

Transcutaneous Electrical Nerve Stimulation. Three trials studied the effectiveness of TENS compared with TENS for chronic LBP.[34,90,91,103] There is no evidence that TENS is an effective treatment for chronic LBP (level 4), because of the contradictory results of the two high quality studies.

Acupuncture. The six trials we identified that studied the effectiveness of acupuncture for chronic LBP were all of low quality.[28,38,55,90,91,97,112,113] Of the four nonpragmatic trials that used placebo acupuncture or a waiting-list control group as reference treatment, two reported a positive result[28,97] and two a negative result.[38,112,113] In the other two pragmatic trials, acupuncture was compared with TENS and placebo TENS,[90,91] or a standard therapy regimen with acupuncture (dry needling) was compared with a standard therapy regimen alone.[55] These two trials reported positive results. Because of the contradictory results, there is no evidence (level 4) that acupuncture is an effective treatment for chronic LBP.

■ Discussion

Limitations of Our Systematic Review

We have put much effort into identifying the relevant RCTs that studied the effectiveness of common conservative treatments for acute and chronic LBP. However, a potential limitation of our review might be the literature search, which for several reasons may have introduced a bias. First, some relevant trials might have been missed because they used other keywords or had unclear abstracts. Second, not all published trials are indexed in databases, and we could have missed some relevant trials published in nonindexed journals. Third, we did not make any effort to identify unpublished trials that, in general, are more likely to have negative results. Fourth, we only included trials published in journals in the English language, excluding potentially relevant trials published in other languages. The identification of all relevant trials is crucial to the validity of a systematic review. Therefore, adequate indexing and registration of published trials and trials currently being conducted should be aimed for, to reduce the possibility of bias.[35]

The choice of the weights that we assigned to the methodologic criteria, obviously, remains arbitrary. The weighting system we used might have influenced the hierarchical order of the trials included in this review. In our previously published review of back schools,[84] we performed a sensitivity analysis by applying three different weighting systems, to evaluate the robustness of the quality assessment. This sensitivity analysis showed more or less the same hierarchical order irrespective of the weighting system used. However, the weighting of methodologic criteria is still under debate.[116] In addition, we did not blind the two independent reviewers, with respect to the source and outcome of the trials. The methodologic criteria we used were quite strict and easy to apply, and we presented our quality assessment in a reproducible manner. However, readers may wish to assign their own weights, including equal weights, and reassess the quality of the trials themselves.

Another limitation of our review might be that the scores for each criterion were combined into a single methodologic score. Assessment of the methodologic quality using a total score suggests that methodologic flaws can be compensated, which is probably not the case. Especially "fatal flaws," such as irrelevant outcome measures, high dropout rates (> 50%), or clinically irrelevant follow-up time (*e.g.*, 30 minutes), can influence the internal validity dramatically in otherwise reasonably well performed trials. An example of this was the study of Sanders et al,[135] which was of methodologic high quality (51 points) but showed a fatal mistake. We did not include this study in our decision-making.

Because we started this review by updating our previously published systematic reviews, we retained the same criteria list.[78,79,84,85] This criteria list, like many other methodologic quality assessment scales,[116] contains items that reflect the internal and external validity and also the precision and quality of the report. Quality assessment scales are still based mainly on general principles of intervention research and not on empirical research.[116] Only recently, Schulz et al[136] provided some empirical evidence that the lack of double-blinding and the inadequacy of allocation concealment are, indeed, associated with bias. Providing empirical evidence of bias for specific methodologic criteria would help to improve quality assessment.

In addition, a limitation of our systematic review might also be that no subgroup analyses could be performed for LBP with and without radiation. Although there may be differences in response to treatment between patients with LBP with and without radiation, many studies report on a mix of patients with LBP with various clinical conditions. Only 37% of the RCTs included in our review reported on a homogeneous study population (Item A). Future RCTs should either evaluate the effectiveness of therapeutic interventions for a clearly defined homogeneous population of patients with LBP or analyze the effectiveness for patients with LBP with and without radiation separately. As in our previously published reviews,[78,79,84,85] we refrained from statistical pooling because of the generally low methodologic quality of the trials and the heterogeneity of the study populations, outcome measures, follow-up time, and reference treatments. However, the methods of statistical

pooling are rapidly being developed further, and we will attempt to quantitatively pool the results of RCTs on LBP in the near future. In this systematic review, we restricted ourselves to qualitative pooling of the available RCTs by using a system for rating the strength of the evidence that included the quality of the trials, the relative value of the various outcome measures, and the consistency of the outcomes of the trials.[15] However, no consensus has been reached yet on the assessment of the strength of the evidence, and further development of the methods of evidence-based medicine is clearly needed.[162]

Methodologic Quality of the Studies

In general, the methodologic quality of the RCTs that studied various therapeutic interventions for acute and chronic LBP appeared to be low. The RCTs that studied drug therapies were, on average, of a higher methodologic quality than the RCTs on other conservative types of treatment. This finding was not very surprising, because the use of a placebo control group and, consequently, the blinding of the patient and the effect measurement is clearly more feasible in drug trials than in trials that evaluate, for example, exercise therapy. We previously discussed the implications of the most common methodologic flaws that occur in RCTs on the effectiveness of treatment for LBP.[86] Except for the size of the study population, which has implications on the power and the external validity, all these methodologic flaws may have implications on the internal validity of the studies and could consequently result in biased outcomes.

Effectiveness of the Therapeutic Interventions

In this review, we assessed the effectiveness of the various interventions for the treatment of acute and chronic LBP, using a rating system for the strength of the scientific evidence. Some problems occurred in assessing the effectiveness of the various conservative treatment options for LBP. A wide variety of reference treatments are used and the outcome of the trials may depend on the effectiveness of the reference treatments. Also, co-interventions are often not prevented or registered, which may indicate that the contrast is not purely the isolated contrast between the index and reference treatments. In addition, different outcome measures were used to evaluate the improvement of the patients, and the same outcome measures may be assessed by different instruments.

Strong evidence was found for the effectiveness of muscle relaxants for acute LBP and for the effectiveness of NSAIDs for uncomplicated acute LBP. Strong evidence also was found against the use of exercise therapy in the treatment of acute LBP. In contrast to the QTF,[139] we did not conclude that there was any evidence in favor of bed rest or back school for the treatment of acute low back pain. The guidelines of the U.S. Agency for Health Care Policy and Research[15] and the guidelines of the Clinical Standards Advisory Group (CSAG) on Back Pain in the United Kingdom[133] recommended the use of acetaminophen, NSAIDs, muscle relaxants, manipulation, and an active exercise approach as acceptable treatment options for acute LBP.

Regarding the treatment of chronic LBP, strong evidence was found for the effectiveness of manipulation, back schools (in an occupational setting), and exercise therapy, especially with regard to short-term effects. Our results regarding chronic LBP are, to a certain extent, in agreement with the guidelines issued by the QTF[139] and the CSAG,[133] which both suggest the importance of multidisciplinary treatment programs, including exercises and a behavioral approach. However, we only found limited evidence for the effectiveness of behavior therapy. Although the results were quite consistent, all RCTs were of low methodologic quality. According to the QTF and CSAG guidelines,[133,139] the major goal in the treatment of chronic LBP is return to work or usual activities, and additional therapeutic options for symptomatic pain relief may facilitate this process. The available evidence suggests that NSAIDs might be effective for this purpose, but not physical modalities such as TENS, electromyographic biofeedback, acupuncture, and orthoses.

The inconsistencies between the results of our systematic review and the recommendations for acute LBP of the guidelines from the U.S. Agency for Health Care Policy and Research,[15] the U.K. (CSAG),[133] and Canada (QTF)[139] may partially be explained by cultural differences in interpretation of the available evidence.[162] For example, if there is moderate or limited evidence that an intervention is effective, this intervention might be advised in a country where the intervention is not frequently used. This might especially be the case if there are no or few alternatives. However, in a country where the intervention has been used frequently, the lack of strong evidence may lead to the advice to lower its use. The inconsistencies may also partially be explained by the use of a more recent update of the literature.

Conclusions

Many therapeutic interventions are available for and used in the treatment of acute and chronic LBP. We believe that the quality of the design, execution, and reporting of RCTs should, and indeed can, be improved, to establish strong evidence for the effectiveness of the various therapeutic interventions for acute and chronic LBP.

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■ Appendix

Table 6. Details of Randomized Controlled Trials on the Effectiveness of Analgesics for Acute Low Back Pain

Reference	Analgesics Dose/Frequency/Duration (no. of patients)	Reference Treatment(s) (no. of patients)	Results
Videman[154]	(I) Meptazinol 200 mg qid/3 wk (35)	(R) Diflunisal 250 mg qid/4 wk (35)	Mean change in degree of pain (100 mm VAS) at 3 wk (I) 45 vs. (R) 40; similar improvement regarding capacity for daily tasks (data in graphs); no significant differences; side effects similar (I) 19 vs. (R) 23 patients
Wiesel[160]	(I1) Acetaminophen (dosage not given)/ bid/2 wk (?) (I2) Codeine 60 mg qid/2 wk (?) (I3) Oxycodone + aspirin 1 tablet qid (?)		Mean (SD) no. of days before return to full activity (I1) 5.6 (0.6), (I2) 5.2 (0.6), (I3) 5.6 (07); no significant differences; no data on side effects given
Brown[23]	(I) Acetaminophen 300 mg + codeine 50 mg/2 caps initially, one caps every 4 hr/15 days (21)	(R) Diflunisal (caps) initial dose 1000 mg; 500 mg every 12 hr/15 days (19)	Pain assessment by patient and investigator on 3-point ordinal scale shows similar improvement curves (data in graphs); no. of patients rating drugs as excellent or very good (I) 9 vs. (R); no significant differences; more side effects in (I) 10 than in (R) 3
Evans[42]	(I1) Dextropropoxyphene 32.5 mg + paracetamol 325 mg/2 caps qid/1 wk (30 c.o.) (I2) Paracetamol 500 mg/2 caps qid/1 wk (30 c.o.)	(R1) Aspirin 300 mg 3 caps qid/1 wk (30 c.o.) (R2) Indomethacin 50 mg tid/1 wk (30 c.o.) (R3) Mefenamic acid 250 mg 2 caps tid/1 wk (30 c.o.) (R4) Phenylbutazone 100 mg tid/1 wk (30 c.o.)	Mean daily pain index during intervention period (4-point ordinal scale) (I1) 1.7, (I2) 1.7, (R1) 1.4, (R2) 1.5, (R3) 1.4, (R4) 1.4; (R3) significantly different from (I1 and I2); (R1) significantly different from (I1); more side effects in (R1) 20, (R2) 19, and (I1) 19 than in (R3) 12, (I2) 13, and (R4) 4
Hackett[56]	(I) Paracetamol 2 tablets every 4 hr (?)	(R) Electroacupuncture 2 treatments in 4 days (?)	Pain scores (VAS) pretreatment and after 1, 2, and 6 wk: (I) 54.5, 23.4, 22.0, 13.7 vs. (R) 52.7, 23.2, 18.3, 3.3; (R) significantly less pain after 6 wk
Nwuga[122]	(I) Analgesics (unspecified) (?)	(R1) Ultrasound (?) (R2) Placebo ultrasound (?)	Proportion of patients pain-free after 4 wk (I) 6.8%, (R1) 40.7%, (R2) 12%; (R1) significantly more improved than (I)

bid = twice per day; qid = four times per day; caps = capsules; c.o. = cross-over; ? = number of patients not given.

Table 7. Details of Randomized Controlled Trials on the Effectiveness of NSAIDs for Acute Low Back Pain

Reference	NSAIDs Dose/Frequency/Duration (no. of patients)	Reference Treatment(s) (no. of patients)	Results
Hosie[68]	(I1) Ibuprofen caps 400 mg tid + placebo foam tid/14 days (147) (I2) Felbinac (foam 3%) tid + placebo caps tid/14 days (140)		Patients (%) reporting none or mild severity after 1 and 2 wk (I1) 84, 92, (I2) 76, 88; no significant differences; no. of side effects (I1) 22, (I2) 26
Amlie[5]	(I) Piroxicam 20 mg caps bid first 2 days, one daily next 5 days/7 days (140)	(R) Placebo caps (142)	(I) More pain relief (VAS) than (R) after 3 days; after 7 days no significant differences; side effects similar (I) 13%, (R) 17%
Goldie[53]	(I) Indomethacin 25 mg caps tid/course of 50 caps (25)	(R) Placebo caps (25)	No. of patients with complete relief of pain after 7 and 14 days (I) 7, 14 (R) 9, 16; no significant differences; side effects similar (I) 8, (R) 5
Weber[158]	(I) Piroxicam 20 mg caps/40 mg per day first 2 days; 20 mg per day next 12 days/14 days (120)	(R) Placebo caps (94)	Reduction of pain in back and leg measured by visual analogue scales after 4 wk the same in the two groups (data in graphs); no significant differences; more side effects in (I) 22 than in (R) 13
Bakshi[9]	(I1) Diclofenac resinate caps 75 mg bid/14 days (66) (I2) Piroxicam caps 20 mg bid for 2 days + once daily for 12 days (66)		Mean pain intensity scores at rest (VAS) pre- and posttreatment: (I1) 70.0, 22.7, (I2) 67.1, 21.0; efficacy excellent or good according to patients: (I1) 81.8%, (I2) 87.7%; no differences; side effects similar (I1) 17, (I2) 15
Blazek[16]	(I1) Diclofenac 25 mg caps/qid first 4 days and tid next 8 days/12 day (14) (I2) Briarison 300 mg caps/qid first 4 days and tid next 8 days/12 days (14)		Average improvement on 5-point ordinal scale (0 = no response, 4 = very good response) during and after the intervention period of 12 days according to physician and patient: (I1) 2.6 and 2.8, (I2) 2.8 and 3; no significant differences in recovery rate; side effects: mild side effects in 3 patients in each group
Szpalski[144]	(I) Tenoxicam 20 mg i.m. injection on day 1 + 20 mg caps 1 day for day 2–14 (+7 days bed rest) (37)	(R) Placebo injection + placebo caps (36)	Mean pain intensity (VAS) on day 1, 8, and 15 (I) 7.4, 1.9, 0.6 (R) 7.1, 2.8, 0.8; (I) significantly better on day 8; side effects: one patient in group (I)
Lacey[87]	(I) Piroxicam 10 mg caps/qid first 2 days, bid next 12 days/14 days (168)	(R) Placebo caps (169)	Patients (%) improved after 1 wk only in subgroups with initial moderate/severe pain (I) 82%/49%, (R) 53%/38%; no differences for subgroup with mild initial pain; results after 2 wk not reported, and no data presented on side effects for subgroup with back pain
Videman[154]	(I) Diflunisal 250 mg caps qid/3 wk (35)	(R) Meptazinol 200 mg caps qid/3 wk (35)	Mean change in pain (100 mm VAS) at 3 wk: (I) 45, (R) 40; similar improvement regarding capacity for daily tasks (data in graphs); no significant differences; side effects similar: (I) 19, (R) 23 patients
Sweetman[143]	(I) Mefenamic acid 500 mg tid + placebo bid (40)	(R1) Chlormezanone 100 mg and paracetamol 450 mg two caps tid + placebo tid (42) (R2) Ethoheptazine 75 mg and meprobamate 150 mg and aspirin 250 mg two caps + placebo tid (40)	No. of patients reporting no pain after 1 and 7 days (I) 7, 21, (R1) 12, 23; (R2) 10, 20; no. of patients with adverse events: (I) 9; (R1) 10; (R2) 16
Orava[125]	(I1) Diflunisal 500 mg caps bid/7 days (66) (I2) Indomethacin 50 mg caps tid/7 days (67)		No. of patients (%) assessing therapy as good or excellent after 3 and 7 days (I1) 45%, 64%, (I2) 45%, 64%; no significant differences; more side effects in (I2) 31% than in (I1) 18%
Wiesel[160]	(I1) Aspirin 625 mg caps qid/2 wk (?) (I2) Phenylbutazone 100 mg caps qid (first 5 days); no further information given (?)	(R) Acetaminophen (dosage not given) bid (2 wk) (?)	Mean no. of days before return to full activity (I1) 5.7; (I2) 6.5; (R) 5.7; no significant differences; no data on side effects given
Agrifoglio[2]	(I1) Aceclofenac 150 mg im injection bid 2 days + tablet 100 mg bid 5 days (50) (I2) Diclofenac 75 mg im injection bid 2 days + tablet 50 mg tid 5 days (50)		No significant difference in pain intensity (VAS) pre- and posttreatment (data in graph); percentage of patients not limited in functional impairment posttreatment: (I1) 65.9%, (I2) 40.5%; significant; overall assessment of efficacy good/very good: (I1) 85%, (I2) 76%; significant; side effects: (I1) 1, (I2) 8
Weber[157]	(I) Phenylbutazone 200 mg/2 caps tid for 3 days; 1 caps tid next 2 days (28)	(R) Placebo caps (29)	No. of patients reporting definite positive effect after intervention period (I) 14, (R) 8; no significant differences; no side effects reported by the patients
Waterworth[156]	(I) Diflunisal 500 mg caps 1000 mg immediately; 500 mg bid/10 days (36)	(R1) Physiotherapy: local heat, ultrasound and exercises, 5 × 45-min session weekly (34) (R2) Spinal manipulation and/or McKenzie therapy, 5 × 45-min sessions weekly (38)	Mean change in pain intensity on 4-point scale after 4 and 12 days: (I) −0.9, −1.7; (R1) −0.9, −1.6; (R2) −1.1, −1.7; no significant differences in pain and mobility

Reference	NSAIDs Dose/Frequency/Duration (no. of patients)	Reference Treatment(s) (no. of patients)	Results
Brown[23]	(I) Diflunisal caps/initial dose 1000 mg; 500 mg every 12 hr/15 days (19)	(R) Acetaminophen 300 mg with codeine 50 mg/2 caps initially; 1 caps every 4 hr/15 days (21)	Pain assessment by patient and investigator on 3-point ordinal scale shows similar improvement curves (data in graphs); no. of patients rating drugs as excellent or very good: (I) 9, (R) 9; no significant differences; side effects: more side effects in (R) 10 than in (I) 3
Evans[42]	(I1) Aspirin 300 mg/3 caps qid/1 wk (30) (I2) Indomethacin 50 mg tid/1 wk (30) (I3) Mefenamic acid 250 mg/2 caps tid/1 wk (30) (I4) Phenylbutazone 100 mg tid/1 wk (30)	(R1) Dextropropoxyphene 32.5 mg + paracetamol 325 mg caps/2 caps qid/1 wk (30) (R2) Paracetamol 500 mg/2 caps qid/1 wk (30)	Mean daily pain index during intervention period (on 4-point ordinal scale): (I1) 1.4, (I2) 1.5, (I3) 1.4, (I4) 1.4, (R1) 1.7, (R2) 1.7; (I3) significantly different from (R1 and R2); (I1) significantly different from (R1); side effects: more side effects in (I1) 20, (I2) 19, (R1) 19 than in (I3) 12, (R2) 13, (I4) 4
Aghababian[1]	(I1) Diflunisal caps/1000 mg initially, 500 mg every 8–12 hr/2 wk (16) (I2) Naproxen caps/500 mg initially, 250 mg every 6–8 hr/2 wk (17)		No. of patients (%) reporting no pain (4-point ordinal scale) after 2 wk: (I1) 81%, (I2) 41%; no significance tests reported; no adverse experiences were reported by the patients
Postacchini[127]	(I) Diclofenac "full dosage"/10–14 days (34)	(R1) Chiropractic manipulation (35) (R2) Physiotherapy (31) (R3) Bed rest (29) (R4) Placebo (antiedema gel) (30)	Mean improvement on combined pain, disability, and spinal mobility score (5–32) after 3 wk, 2 and 6 mo: (I) 3.0, 10.7, 14.0; (R1) 7.5, 9.7, 12.3; (R2) 5.0, 8.4, 10.2; (R3) 5.4, 7.5, 7.3; (R4) 1.8, 7.3, 11.0; (R1) significantly better than others after 3 wk; no other differences; no data on side effects reported

bid = twice per day; tid = three times per day; qid = four times per day; caps = capsules; ? = number of patients not given; NSAIDs = nonsteroidal anti-inflammatory drugs.

Table 8. Details of Randomized Controlled Trials on the Effectiveness of Muscle Relaxants for Acute Low Back Pain

Reference	Muscle Relaxants Dose/ Frequency/Duration (no. of patients)	Reference Treatment(s) (no. of patients)	Results
Berry[14]	(I) Tizanidine 4 mg plus ibuprofen 400 mg tid/7 days (51)	(R) Placebo plus ibuprofen 400 mg tid/7 days (54)	Mean changes (SD) in pain score (VAS 100 mm) after 3 days (I) pain at night 20 (32.8), pain at rest 18 (25.3), and pain walking 23 (25.4) vs. (R) 22 (34.6), 16 (24.9) and 13 (22.6); after 7 days (I) 32 (39.5), 29 (43.3) and 36 (34.1) vs. (R) 33 (39.8), 33 (32.9) and 30 (32.8); percentage of patients improved after 3 days (I) 76% vs. (R) 67%, and after 7 days (I) 85% vs. (R) 81%; no significant differences; (I) significantly more central nervous system side effects, (R) significantly more gastrointestinal side effects; significantly fewer patients had moderate or severe pain at rest or pain at night in (I) than in (R)
Baratta[10]	(I) Cyclobenzaprine 10 mg tid–qid/10 days (58)	(R) Placebo tid–qid/10 days (59)	Mean decrease in pain (10-point scale) from day 1 to 9 (I) −0.8 to −5.5 vs. (R) −0.3 to −4.0; (I) significantly better; moderate to marked global improvement (I) 71% vs. (R) 25%, significant; significantly more central nervous side effects in (I)
Casale[27]	(I) Dantrolene sodium 25 mg 1 caps per day/4 days (10)	(R) Placebo 1 caps per day/4 days (10)	Pain during maximal voluntary movement (VAS) decreased significantly more in (I) than in (R); muscle spasm significantly more improved in (I) 85% than in (R) 30%
Boyles[21]	(I1) Carisoprodol 350 mg qid/8 days (36)	(I2) Diazepam 5 mg qid/8 days (35)	Patient's assessment of muscle tension, stiffness, and overall relief significantly more improved in (I1) than in (I2) after 6 and 7 days; no significant difference in pain; physician's assessment of overall improvement and muscle spasm significantly better in (I1) than in (I2) after 7 days, but not after 3 days; data in graphs
Hindle[66]	(I) Carisoprodol 350 mg qid/4 days (16)	(R1) Placebo qid/4 days (16) (R2) Butabarbital 15 mg/qid/4 days (16)	Pain score (VAS 0–100) at baseline and after 2 and 4 days (I) 86.0, 33.0, and 15.5, (R1) 65.5, 58.5, and 64.0, (R2) 75.2, 58.7, and 49.1; (I) significantly more improved; ADL significantly more improved in (I) than in (R1) and (R2), but not muscle spasm
Middleton[114]	(I1) Methocarbamol 400 mg plus acetyl salicylic acid 325 mg/2 tabl qid/7 days (55)	(I2) Chlormezanone 100 mg plus paracetamol 450 mg/2 tabl tid/7 days (52)	Percentage of patients with moderate to very severe pain on day 1 and day 7 in (I1) 87% and 51% vs. (I2) 85% and 52%; percentage of patients with overall improvement posttreatment (I1) 66% vs. (I2) 61%; not significant; significantly more side effects in (I2) than (I1)
Dapas[30]	(I) Baclofen 10 mg/1–2 tabl tid–qid/10 days (100)	(R) Placebo 2 tabl qid/10 days (100)	For patients with severe symptoms at baseline, (I) significantly more improved at day 10 in pain, patient's opinion, ADL, muscle spasm, and spinal mobility; significantly more side effects in (I)

Reference	Muscle Relaxants Dose/ Frequency/Duration (no. of patients)	Reference Treatment(s) (no. of patients)	Results
Rollings[132]	(I1) Carisoprodol 350 mg qid/7 days (28)	(I2) Cyclobenzaprine HCL 10 mg qid/7 days (30)	No statistically significant differences between (I1) and (I2) on pain, muscle stiffness and tension, ADL, and overall relief, data in graphs
Berry[13]	(I) Tizanidine 4 mg tid/7 days (59)	(R) Placebo tid/7 days (53)	Mean (SD) pain score (VAS 100 mm) at baseline and after 3 and 7 days: pain at night (I) 51 (31.5), 39 (32.3) and 15 (20.6) vs. (R) 52 (33.1), 38 (28.8) and 18 (20.8); pain at rest (I) 51 (29.4), 39 (29.6) and 19 (23.2) vs. (R) 51 (26.9), 34 (27.9) and 19 (22.9); pain on movement (I) 55 (30.0), 46 (30.4) and 18 (22.9) vs. (R) 49 (27.8), 36 (25.6) and 18 (23.1); no differences between (I) and (R); overall improvement after 3 and 7 days (I) 17% and 84% of patients and (R) 8% and 82% of patients; not significant; side effects in (I) 41% and (R) 21%; (I) significantly more central nervous system side effects, (R) significantly more gastrointestinal side effects
Gold[52]	(I) Orphenadrine citrate 100 mg bid/7 days (20)	(R1) Placebo bid/7 days (20) (R2) Phenobarbital 32 mg bid/7 days (20)	No. of patients improved after 2 days (I) 7, (R1) 0, (R2) 3; (I) significantly more improved that (R1); no. of patients with reduced pain after 2 days (I) 9, (R1) 4, (R2) 3; (I) significantly more reduced than (R1) and (R2); no. of patients with side effects (I) 5, (R1) 1, (R2) 2
Sweetman[143]	(I) Chlormezanone 100 mg plus paracetamol 450 mg/2 caps tid/7 days (42)	(R1) Mefenamic acid 500 mg tid/7 days (40) (R2) Ethoheptazine 75 mg plus meprobamate 150 mg plus aspirin 250 mg 2 tabl tid/7 days (40)	No. of patients with overall improvement after 7 days (I) 24, (R1) 24, (R2) 22; not significant; no. of patients reporting side effects on day 7 (I) 5, (R1) 5, (R2) 13; significant
Borenstein[20]	(I) Cyclobenzaprine 10 mg tid plus naproxen 500 mg initially, 250 mg qid/14 days (20)	(R) Naproxen 500 mg initially, 250 mg qid/14 days (20)	Treatment outcome significantly better on muscle spasm and tenderness in (I) than (R); no significant differences on pain and functional capacity; significantly more side effects in (I) than (R)
Hingorani[67]	(I) Diazepam 10 mg/4 im injections 24 hr plus 2 mg oral qid/5 days plus aspirin 10 g tid/5 days (25)	(R) Placebo 4 injections 24 hr plus oral qid/5 days plus aspirin 10 g tid/5 days (25)	No. of patients improved (I) 19 vs. (R) 18; side effects: drowsiness in (I) 7 patients vs. 3 in (R)
Tervo[145]	(I) Orphenadrine im injection 60 mg 2 ml plus oral orphenadrine citrate 35 mg plus paracetamol 450 mg/2 tabl tid/8 days (25)	(R) Placebo saline injection 2 ml plus oral paracetamol 450 mg/2 tabl tid/8 days (25)	No significant differences in subjective impression of improvement, muscle spasm, and spinal flexion; walking and sitting ability significantly more improved in (I) than (R); side effects in (I) 2 patients and (R) 1 patient

bid = twice per day; tid = three times per day; qid = four times per day; tabl = tablet; caps = capsules; ? = number of patients not given; ADL = activities of daily living.

Table 9. Details of Randomized Controlled Trials on the Effectiveness of Epidural Steroid Injections for Acute Low Back Pain

Reference	Epidural Steroid Injection (no. of patients)	Reference Treatment (no. of patients)	Results
Mathews[106]	(I) 80 mg (2 ml) methylprednisolone + 20 ml bupivacaine 0.125%, caudal route (23)	(R) 2 ml lignocaine, subcutaneously (34)	No. of patients recovered after 1 mo (I) 67%, (R) 56%; not significant; after 3 mo (I) significantly more pain-free than (R)

Table 10. Details of Randomized Controlled Trials on the Effectiveness of Bed Rest for Acute Low Back Pain

Reference	Treatment With Bed Rest (no. of patients)	Reference Treatment(s) (no. of patients)	Results
Deyo[33]	(I1) Bed rest (2 days recommended) (101) (I2) Bed rest (7 days recommended) (102)		No differences in functional status, self-rated and clinician-rated improvement, and duration of pain after 3 wk and 3 mo; no. of days absent from work after 3 wk: (I1) 3.1, (I2) 5.6, significant
Gilbert/Evans[40,49]	(I1) Bed rest at least 4 days (instructed) (60) (I2) Bed rest at least 4 days (instructed) and physiotherapy and instruction (65)	(R1) Exercise and education (62) (R2) No intervention (65)	No. of patients reporting no pain after 6 and 12 wk: (I1) 34, 37, (I2) 33, 46, (R1) 36, 44, (R2) 33, 43; no significant differences in pain, mobility, or daily activities

Reference	Treatment With Bed Rest (no. of patients)	Reference Treatment(s) (no. of patients)	Results
Malmivaara[99]	(I) Complete bed rest for 2 days, routine activities as tolerated thereafter (67)	(R) Continuation of ordinary activities as tolerated (67)	Differences in adjusted group means (95% CI) of (I) minus (R) on pain intensity (11-point scale), functional status (Oswestry), and satisfaction with treatment (11-point scale) after 3 wk 0.3 (−0.4 to 0.9), 3.9 (−0.2 to 8.0), and −0.7 (−1.8 to 0.4) and after 12 wk 0.7 (0.03 to 1.4), 3.8 (0.1 to 7.5), and −0.6 (−1.6 to 0.4); pain intensity and functional status significantly better in (I) after 12 wk
Wilkinson[161]	(I) Complete bed rest for 48 hr (20)	(R) No daytime rest and remaining mobile (22)	Mean (SD) functional status (Roland) at day 1, 7, and 28: (I) 13.9 (5.4), 9.7 (19.9), 5.9 (5.6) and (R) 11.0 (11.0), 5.3 (5.7), 3.2 (4.0); (I) significantly more improved between day 7 and 28; no differences in mobility and time off work
Postacchini[127]	(I) 20–24 hr for the first 4–6 days and 15–20 hr a day for a further 2 days (29)	(R1) Manipulation (daily first week and then twice a week for 3 wk) (35) (R2) NSAIDs, 10–14 days (34) (R3) Physiotherapy: light massage, analgesic current and infrared: daily for 2–3 wk (31) (R4) Placebo: antiedema gel to be spread on the lumbar region twice a day for 1 or 2 wk (30)	Mean improvement on combined pain, disability, and spinal mobility score (range 5–32) after 3 wk, 2 and 6 mo; in subgroup with acute LBP only (I) 5.4, 7.5, 7.3, (R1) 7.5, 9.7, 12.3, (R2) 3.0, 10.7, 14.0, (R3) 5.0, 8.4, 10.2, (R4) 1.8, 7.3, 11.0; (R1) significantly better after 3 wk; no other differences
Wiesel[160]	(I) Bed rest in hospital for maximal 14 days (?)	(R) Ambulatory treatment without physical exercise (patients are kept on their feet) (?)	Average (SE) no. of pain points within 2 wk (I) 51.7 (5.3), (R) 107.6 (10.1), significant; no. of days (SE) before return to work (I) 6.6 (0.23), (R) 11.8 (0.12), significant

NSAIDs = nonsteroidal anti-inflammatory drugs.

Table 11. Details of Randomized Controlled Trials on the Effectiveness of Exercise Therapy for Acute Low Back Pain

Reference	Exercise Regimen (no. of patients)	Reference Treatment (no. of patients)	Results
Faas[43,44]	(I) Stretching, flexion, side movements, and advice (156)	(R1) Usual care by general practitioner: analgesics, information (155) (R2) Placebo ultrasound therapy (162)	No significant differences in no. of recurrences, duration of pain, or functional status (NHP) during 1 yr follow-up; only NHP-energy more improved in (I) than in (R1) during first 3 mo
Evans/Gilbert[40,49]	(I1) Isometric flexion, education, bed rest (65) (I2) Isometric flexion, and bed rest (62)	(R1) Bed rest (60) (R2) No intervention (65)	No. of patients reporting no pain after 6 and 12 wk: (I1) 34, 47, (I2) 33, 46, (R1) 36, 44, (R2) 33, 43; no significant differences in pain, mobility, or daily activities
Malmivaara[99]	(I) Mobilizing exercises: back-extension and lateral bending (52)	(R) Continuation of ordinary activities as tolerated (67)	Differences in adjusted group means (95% CI) between (I) and (R) on pain intensity (11-point scale), functional status (Oswestry), and satisfaction with treatment (11-point scale) after 3 wk 0.9 (−0.001 to 1.7), 6.6 (2.0 to 11.1), and 0.5 (−0.6 to 1.6) and after 12 wk 0.2 (−0.5 to 1.0), 2.6 (−1.6 to 6.7), and 0.4 (−0.6 to 1.4)
Stankovic[140,141]	(I) McKenzie extension (50)	(R) Mini-back school (50)	Significantly less pain and better spinal mobility in (I) at 3 wk and after 1 yr (no data); no. of recurrences after 1 and 5 yr significantly less in (I) 22/49, 30/47 than (R) 37/46, 37/42
Waterworth[156]	(I) Flexion and extension, shortwave diathermy and ultrasound (34)	(R1) NSAIDs (36) (R2) Manipulation (38)	Mean change in pain intensity on 4-point scale after 4 and 12 days: (I) −0.9, −1.6, (R1) −0.9, −1.7, (R2) −1.1, −1.7; no significant difference in pain or mobility
Nwuga[121]	(I) Isometric flexion back and abdominal muscles and microwave diathermy (25)	(R) Manipulation (26)	Improvement in spinal flexion and SLR: (I) 13°, 4°, (R) 34°, 39°; manipulation significantly better than exercise
Farrell[45]	(I) Isometric flexion abdominal muscles in microwave diathermy (24)	(R) Manipulation and mobilization (24)	(R) symptom-free in significantly less days than (I)

Reference	Exercise Regimen (no. of patients)	Reference Treatment (no. of patients)	Results
Davies[31]	(I1) Extension and shortwave diathermy (14) (I2) Isometric flexion and shortwave diathermy (14)	(R) Shortwave diathermy (15)	No. of patients showing improvement after 2 and 4 wk: (I1) 11, 13, (I2) 7, 12, (R) 8, 10; not significant
Delitto[32]	(I1) McKenzie extension and mobilization (14) (I2) Williams flexion (10)		(I1) significantly more improved on functional status (Oswestry) than (I2) after 3 and 5 days (data in graphs)
Nwuga[123]	(I1) McKenzie extension (31) (I2) Williams flexion (31)		Change in 10-point pain rating after 6 wk (I1) −5.3 vs (I2) −2.7; (I1) significantly better than (I2)

NSAIDs = nonsteroidal anti-inflammatory drugs; SLR = straight leg raising.

Table 12. Details of Randomized Controlled Trials on the Effectiveness of Back Schools for Acute Low Back Pain

Reference	Back School Program (no. of patients)	Reference Treatment(s) (no. of patients)	Results
Bergquist[11]	(I) Swedish back school: 4 × 45 min in 2 wk (lessons include information on anatomy, causes of LBP, semi-Fowler position, ergonomics, exercises, and advice on physical activity) (70)	(R1) Combined physical therapy: manual therapy according to Cyriax, Kaltenborn, Lewitt, and Janda (72) (R2) "Placebo": short-waves at lowest intensity; a maximum of 10 treatments (75)	Mean number of days until recovery (I) 14.8 (R1) 15.8 (R2) 28.7; (I) significantly better than (R2), but not (R1); no differences in decrease of pain after 3 and 6 wk
Stankovic[140,141]	(I) Mini-back school: one lesson of 45 min on back care and education (50)	(R) McKenzie method: 20 min exercises and postural instructions to restore or maintain lumbar lordosis (50)	Less pain in (R) than (I) after 3 and 52 wk (no data)
Lindequist[93]	(I) Postural education "back school type" and training program supervised by physiotherapist (24)	(R) Advice not to strain the back and to use analgesics when needed; no physiotherapy (32)	Percentage of patients pain-free after 1, 3, and 6 wk: (I) 21, 75, 83 (R) 16, 66, 81; no significant differences
Morrison[117]	(I) Outpatient back program including education (body mechanics, causes and remediation, psychological stress) and exercise (increasing physical strength and mobility): six 3-hr sessions over 2, 3, or 6 wk period (?)	(R) Control group (no further information) (?)	Significantly more improvement with regard to body mechanics, physical strength, mobility, and physical ability in (I) vs. (R) after the program

Table 13. Details of Randomized Controlled Trials on the Effectiveness of Spinal Manipulation for Acute Low Back Pain

Reference	Manipulation (no. of patients)	Reference Treatment (no. of patients)	Results
MacDonald[98]	(I) Osteopathic (49)	(R) Exercises and postural advice (46)	All patients: no significant different recovery rates between treatment groups; in subgroup with current attack duration of 2–4 wk: (I) 46% (R) 17% recovered after 1 wk
Sanders[135]	(I) Chiropractic (6)	(R1) No treatment (6) (R2) Sham manipulation (6)	Mean pain scores (VAS) slightly reduced in (I) 5 and 30 min after intervention; no changes found in (R1) or (R2); no statistics on group differences presented
Hadler[57]	(I) Rotational (26)	(R) Spinal mobilization (28)	All patients: no difference in functional status (Roland); in subgroup with current attack duration of 2–4 wk better results in manipulation group (I) after 1 wk
Bergquist[11]	(I) Cyriax, Kaltenborn, Lewitt, Janda (72)	(R1) Low intensity shortwave diathermy (75) (R2) Back school (70)	Mean no. of days until recovery (I) 15.8, (R1) 28.7, (R2) 14.8; (I) and (R2) significantly better than (R1); no significant differences (I) and (R2)
Mathews[107]	(I) Cyriax (165)	(R) Infrared heat (126)	Percentage of patients recovered after 2 wk in subgroup (n = 58) with SLR− 62% (I) vs. 70% (R), in subgroup (n = 233) with SLR+ 80% (I) vs. 67% (R); manipulation significantly better in subgroup with SLR+
Helliwell[62]	(I) Cyriax (6)	(R) Analgesics (8)	Combined symptom score (max 28) after 1 wk 2.6 ± 2.6 (I) vs. 3.8 ± 3.3 (R) and after 4 wk 6.1 ± 7.2 (I) vs. 2.2 ± 2.5 (R); no significant differences
Glover[50]	(I) Rotational (43)	(R) Detuned shortwave diathermy (41)	Pain relief on VAS posttreatment and after 3 and 7 days: (I) 34%, 50%, 75% vs. (R) 22%, 56%, 80%

Reference	Manipulation (no. of patients)	Reference Treatment (no. of patients)	Results
Blomberg[17–19]	(I) SI-joint mobilization and thrust techniques (48)	(R) Active, optimal conventional physiotherapeutic treatment (53)	Mean pain score (VAS) after 1, 2, and 4 mo: (I) 13.7, 11.4, 8.5; (R) 23.9, 19.3, 20.9. (I) significantly better; average no. of days on sick-leave during 8-mo-follow-up: (I) 25.4, (R) 58.5
Rasmussen[128]	(I) Rotational (12)	(R) Shortwave diathermy (12)	Percentage of patients with total recovery after 2 wk 92% (I) vs. 25% (R); manipulation significantly better
Delitto[32]	(I) Mobilization SI-joint (14)	(R) Flexion exercises (10)	Group (I) significantly more improved in functional status (Oswestry) after 3 and 5 days vs. group (R)
Farrell[45]	(I) Stoddard, Maitland (24)	(R) Shortwave diathermy and exercises (24)	Group (I) symptom-free in significantly less days than group (R)
Nwuga[121]	(I) Rotational (26)	(R) Shortwave diathermy and exercises (25)	Improvement after 6 wk in spinal flexion 34° (I) vs. 13° (R) and in SLR 39° (I) vs. 4° (R); group (I) significantly better than group (R)
Waterworth[156]	(I) At discretion of therapist (38)	(R1) Shortwave diathermy, ultrasound, and exercises (34) (R2) NSAIDs (36)	Mean change in pain intensity on 4-point scale after 4 and 12 days: (I) −1.1, −1.7, (R1) −0.9, −1.6, (R2) −0.9, −1.7; no significant differences in pain intensity and mobility
Postacchini[127]	(I) Chiropractic manipulation (35)	(R1) Physiotherapy (31) (R2) NSAIDs (34) (R3) Bed rest (29) (R4) Placebo: anti-edema gel (30)	Mean improvement on combined pain, disability, and spinal mobility score after 3 wk 7.5 (I), 5.0 (R1), 3.0 (R2), and 5.4 (R3), 1.8 (R4), after 2 mo 9.7 (I), 8.4 (R1), 10.7 (R2), 7.5 (R3), 7.3 (R4) and after 6 mo 12.3 (I), 10.2 (R1), 14.0 (R2), 7.3 (R3), 11.0 (R4); manipulation significantly better after 3 wk
Wreje[163]	(I) SI-joint mobilization (18)	(R) Massage (21)	Pain (VAS) after 3 wk not different (data in graphs); sick-leave and analgesic consumption significantly less in (I) than (R)
Godfrey[51]	(I) Rotational (44)	(R) Massage and electrical stimulation (37)	Percentage of patients with moderate/marked improvement on general symptomatology on a 5-point scale after 2 wk 77% (I) vs. 70% (R); no significant differences on other outcome measures

NSAIDs = nonsteroidal anti-inflammatory drugs; SLR = straight leg raising.

Table 14. Details of Randomized Controlled Trials on the Effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS) for Acute Low Back Pain

Reference	TENS/Acupuncture (no. of patients)	Reference Treatment(s) (no. of patients)	Results
Herman[63]	(I) Rehabilitation program (4 hr per day, 5 days/wk, 4 wk) plus TENS (15 min high frequency, 15 min low frequency, 5 days/wk, 4 wk) (29)	(R) Rehabilitation program plus placebo TENS (29)	Mean (SD) scores pretreatment and posttreatment of functional status (RDQ) (I) 12.5 (5.1), 8.9 (5.0) vs. (R) 14.3 (5.2), 9.9 (6.4), pain (100 mm VAS) (I) 42.7 (23.3), 35.8 (27.7) vs. (R) 47.9 (21.3), 35.9 (27.0) and lumbar flexion (Schober test mm) (I) 50.9 (16.2), 60.2 (10.5) vs. (R) 44.8 (15.9), 61.7 (13.9); not significant
Hackett[56]	(I) TENS low amplitude, 15 min, 2 treatments, 4 days (−)	(R) Paracetamol 2 tablets every 4 hr (−)	Scores for pain (VAS) pretreatment and after 6 wk (I) 52.7, 3.3 vs. (R) 54.4, 13.7; significant after 6 wk, but not after 1 and 2 wk; scores for mobility (VAS) pretreatment and after 6 wk (I) 53.4, 1.9 vs. (R) 51.2, 15.8; significant after 6 wk, but not after 1 and 2 wk

TENS = transcutaneous electrical nerve stimulation.

Table 15. Details of Trials on the Efficacy of Traction for Acute Low Back Pain

Reference	Traction (no. of patients)	Reference Treatment (no. of patients)	Results
Larson[89]	(I) Autotraction plus corset plus bed rest, 1 hr, 1−3 treatments, 1 wk (41)	(R) Corset plus bed rest (41)	No. of patients improved after 1 wk, 3 wk, and 3 mo (I) 17/41, 20/41, 19/41, (R) 2/41, 8/41, 17/41; (I) significantly better after 1 and 3 wk
Mathews[105]	(I) Continuous motorized traction >45 kg, 30 min, 5 days per week, max 3 wk (83)	(R) Infrared heat 15 min, 3 times per week, 2−3 wk (60)	Recovery after 2 wk (I) 40/77, (R) 27/54; not significant

Table **16. Details of Trials on the Efficacy of Behavioral Therapy for Acute Low Back Pain**

Reference	Behavioral Therapy (no. of patients)	Reference Treatment (no. of patients)	Results
Fordyce[46]	(I) Behavioral management; analgesics and exercise continued on a fixed time interval (57)	(R) Traditional management: analgesics and exercise until pain had subsided (50)	Mean (SD) score on pain drawings and claimed impairment after 9–12 mo (I) 1.98 (2.46), 4.84 (3.20) vs. (R) 3.06 (2.45), 6.25 (3.25); (I) significantly better than (R) after 9–12 mo on pain drawings and claimed impairment; no significant differences after 6 wk

Table **17. Details of Randomized Controlled Trials on the Effectiveness of Various Drug Therapies for Chronic Low Back Pain**

Reference	Dose/Frequency/Duration (no. of patients)	Reference Treatment(s) (no. of patients)	Results
Analgesics			
Hickey[65]	(I) Paracetamol 1000 mg qid/4 wk (13)	(R) Diflunisal 500 mg bid/4 wk (16)	No. of patients with none or mild LBP after 2 and 4 wk (I) 9, 7 (R) 11, 13; significantly more patients in (R) 10 of 16 considered the therapy as good of excellent vs. (I) 4 of 12; side effects comparable (I) 1 and (R) 2
Muscle relaxants			
Arbus[6]	(I) Tetrazepam 50 mg tid/10 days (25)	(R) Placebo tid/10 days (25)	Overall efficacy significantly better in (I) 64% than in (R) 29%; mean (SD) pain score (5-point scale) at baseline and after 4 and 10 days in (I) 3.40 (0.82), 2.50 (0.94), and 1.73 (1.31) vs. (R) 3.36 (0.62), 3.10 (0.71), and 2.38 (1.08); (I) significantly more improved; no difference in side effects
Antidepressants			
Goodkin[54]	(I) Trazodone 50 mg/1 tabl initially to maximum 12 tabl per day/6 wk (22)	(R) Placebo (20)	Mean (SD) pain score (VAS) pre- and posttreatment (I) 6.5, 5.3 vs. (R) 6.5, 5.9; physical functioning (SIP) (I) 26.7, 24.4 vs. (R) 27.7, 22.8; psychosocial functioning (SIP) (I) 28.5, 29.0 vs. (R) 27.0, 20.8; depression (BDI) (I) 16.3, 14.1 vs. (R) 15.2, 11.8; pain and depression not significantly different, placebo significantly better physical and psychosocial functioning
Alcoff[3]	(I) Imipramine 75 mg/1–2 tabl per day/8 wk (28)	(R) Placebo (22)	(I) significantly better than (R) in decreasing limitation of physical functioning, no significant difference in pain severity or depression; no means and SDs presented for any outcome measure
Jenkins[71]	(I) Imipramine 25 mg/3 tid/4 wk (23)	(R) Placebo (21)	No differences between (I) and (R) on improvement of pain, depression, and spinal mobility from pre- to posttreatment; data in graphs; in the 15 most depressed patients depression decreased in (I) 6 of 8 subjects vs. (R) 3 of 7 subjects; not significant
Pheasant[126]	(I) Amitriptyline 50 mg/1–3 tabl per day/6 wk (9)	(R) Placebo: atropine 0.2 mg/1–3 tabl per day/6 wk (9)	Crossover design; change in functional evaluation (I) 0.00, (R) −0.06; not significant; mean no. (SD) of analgesics per week (I) 4.7 (3.4) vs. (R) 8.7 (4.8); significant
NSAIDs			
Hickey[65]	(I) Diflunisal 500 mg bid/4 wk (16)	(R) Paracetamol 1000 mg qid/4 wk (13)	No. of patients with none or mild LBP after 2 and 4 wk (I) 11, 13 (R) 9, 7; significantly more patients in (I) 10 of 16 considered the therapy as good or excellent vs. (R) 4 of 12; side effects comparable (I) 2 and (R) 1
Siegmeth[138]	(I1) Ibuprofen/1200 mg day/14 days (15) (I2) Diclofenac/75 mg day/14 days (15)		No. of patients reporting to be improved after 1, 3, and 4 wk (I1) 5, 10, 6 (I2) 5, 12, 11; no significant differences; side effects comparable; one in each group
Videman[153]	(I1) Piroxicam 20 mg day/6 wk (14) (I2) Indomethacin 25 mg tid/6 wk (14)		Mean improvement on VAS (range 0–31) after 6 wk (I1) 8 vs. (I2) 9; similar improvement rates (data in graphs); comparable side effects (I1) 13 vs. (I2) 15
Berry[12]	(I1) Naproxen sodium 550 mg bid/14 days (37) (I2) Diflunisal 500 mg bid/14 days (37)	(R) Placebo (37)	Crossover design: (I1) reduction of pain (VAS) (I2) no change (R) increase of pain (data in graphs); (I1) significantly better than (R) and somewhat better than (I2); side effects comparable in the three groups (I1) 18, (I2) 18, (R) 16

Reference	Dose/Frequency/Duration (no. of patients)	Reference Treatment(s) (no. of patients)	Results
Matsumo[108]	(I1) Ketoprofen 150 mg day/duration not given (77) (I2) Diclofenac 75 mg day/duration not given (78)		Patients improved after 1 and 2 wk (I1) 71%, 86%, (I2) 62%, 79%; no significant differences; side effects comparable in both groups: (I1) 18%, (I2) 21%
Postacchini[127]	(I) Diclofenac "full dosage" 15–20 days (81)	(R1) Manipulation (87) (R2) Physiotherapy (78) (R3) Back school (50) (R4) Antiedema gel (73)	Mean improvement on combined pain, disability, and spinal mobility score after 3 wk, 2 and 6 mo in subgroup with chronic pain (I) 2.6, 2.2, 4.0, (R1) 2.2, 2.6, 4.3, (R2) 3.9, 4.2, 6.0, (R3) 0.5, 4.6, 8.9, (R4) 0.7, 1.2, 2.0; group (I) not significantly better; no data on side effects reported

NSAIDs = nonsteroidal anti-inflammatory drugs; tabl = tablets; bid = twice per day; tid = three times per day.

Table 18. Details of Randomized Controlled Trials on the Effectiveness of Epidural Steroid Injections for Chronic Low Back Pain

Reference	Epidural Steroid Injection, Route (no. of patients)	Reference Treatment (no. of patients)	Results
Breivik[22]	(I) Methylprednisolone 80 mg (2 ml) + 20 ml bupivacaine 0.25%, caudal route, 1–3 injections (16)	(R) Bupivacaine 20 ml 0.25% + 100 ml saline (19)	Percentage of patients with considerable pain relief and objective neurological improvement (before crossover) (I) (56% (R) (26%; significant
Bush[25]	(I) Triamcinolone 80 mg + 25 ml procaine 0.5%, caudal route, 2 injections (12)	(R) Saline 25 ml (11)	Mean VAS (100 mm) of back and leg pain at baseline, 4 and 52 wk (I) 39, 16, 14 (R) 49, 45, 30; mean straight leg raising (SLR, °) at baseline, 4 and 52 wk (I) 44, 73, 80 (R) 63, 65, 74; short-term (I) significantly better results on pain and SLR; long-term (I) significantly better SLR
Cuckler[29]	(I) Methylprednisolone 80 mg (2 ml) + 5 ml procaine 1%, lumbar route, 1–2 injections (42)	(R) Saline 2 ml + 5 ml procaine 1% (31)	Average subjective improvement after 24 hr (I) 42% (R) 44%; not significant; long-term follow-up (about 20 mo) showed no significant differences
Serrao[137]	(I) Prednisolone 80 mg + 10 ml saline (epidural) + 3 ml dextrose (intrathecal), lumbar route, 1 injection (14)	(R) Saline 10 ml (epidural) + 2 mg midazolam + 3 ml dextrose 5% (intrathecal) (14)	No. of patients reporting overall improvement initially and after 2 mo (I) 3, 5 (R) 10, 7; (R) significantly better short-term improvement; no significant differences for pain and activity scores; (R) significantly less self-administered medications
Rocco[131]	(I1) Triamcinolone 75 mg (10.9 ml) + 50 mg lignocaine, lumbar route (8), 1–3 injections; (I2) Triamcinolone 75 mg + 50 mg lignocaine + 8 mg morphine (10.9 ml), 1–3 injections (7)	(R) Lignocaine 50 mg + 8 mg morphine (10.9 ml) (7)	Mean improvement on pain (VAS) after 1 and 6 mo (I1) 0.9, 2.2 (I2) −0.6, −1.7 (R) 0.4, −0.8; no. of patients reporting pain relief after 1 and 6 mo (I1) 5, 1, (I2) 6, 0, (R) 7, 0; no significant differences
Ridley[129]	(I) Methylprednisolone 80 mg + 10 ml saline, lumbar route (19)	(R) Saline 2 ml, interspinous ligament (16)	Percentage of patients improved after 2 wk (I) 90%, (R) 19%; short-term (I) significantly better than (R) in relieving pain

Table 19. Details of Randomized Controlled Trials on the Effectiveness of Manipulation for Chronic Low Back Pain

Reference	Manipulation (no. of patients)	Reference Treatment (no. of patients)	Results
Koes[80–83]	(I) Spinal manipulation and mobilization (65)	(R1) Physiotherapy (66) (R2) Usual care by GP (61) (R3) Detuned shortwave diathermy and detuned ultrasound (64)	No differences on pain and functional status; mean improvement for main complaint (10-point scale) after 3 wk (I) 2.3, (R1) 2.0, (R2) 1.3, (R3) 1.7, after 6 wk (I) 3.4, (R1) 3.4, (R2) 2.0, (R3) 2.7, after 12 wk (I) 4.0, (R1) 3.8, (R2) 3.9, (R3) 3.8; global perceived effect (6-point scale) after 3 wk (I) 2.5, (R1) 2.6, (R2) 1.6, (R3) 2.1, after 6 wk (I) 3.4, (R1) 3.3, (R2) 1.9, (R3) 2.8, after 12 wk (I) 3.4, (R1) 3.7, (R2) 2.2, (R3) 3.3; group (I) and (R1) significantly better than group (R2), no differences between group (I) and (R1); (I) significantly better global perceived effect than (R3)
Ongley[124]	(I) Bourdillon (40)	(R) Nonforceful manipulation (41)	Mean (SEM) pain score (VAS) after 1, 3, and 6 mo: (I) 2.1 (0.2), 1.8 (0.2), 1.5 (0.2) vs. (R) 3.1 (0.3), 2.9 (0.3) and 3.1 (0.3); all differences significant

Reference	Manipulation (no. of patients)	Reference Treatment (no. of patients)	Results
Triano[146]	(I) High velocity low amplitude (?)	(R1) Back education (46) (R2) High velocity low force mimic (?)	Mean pain score (VAS) at baseline, after 2 wk and 2 wk after treatment (I) 38.4, 13.9, and 13.3 and (R1) 35.6, 19.6, and 15.1, (R2) 37.4, 19.8, 21.7, respectively; (I) significantly more improved on pain score after 2 wk than (R1); mean functional status score (Oswestry) at baseline, after 2 wk and 2 wk after treatment (I) 17.5, 9.5, and 10.6 and (R1) 20.2, 12.3, and 11.4, (R2) 21.7, 15.5, 14.0, respectively; no significant differences
Gibson[48]	(I) Osteopathic (41)	(R1) Shortwave diathermy (34) (R2) Detuned shortwave diathermy (34)	Percentage of patients free of pain after 4 wk (I) 28%, (R1) 28%, (R2) 42% and after 12 wk (I) 42%, (R1) 37%, (R2) 44%; not significant; median pain scores (VAS) at baseline and after 2, 4, and 12 wk (I) 35, 25, 21, 13, (R1) 45, 35, 28, 25, (R2) 48, 28, 27, 6; not significant
Herzog[64]	(I) Chiropractic (16)	(R) Back school (13)	Group (R) significantly better improvement no pain, functional status (Oswestry) than (I), (I) significantly better on gait symmetry than (R)
Evans[41]	(I) Rotational (15)	(R) Analgesics (17)	No. of patients assessing treatment as effective after 3 wk 9 (I) vs. 3 (R); significant
Waagen[155]	(I) Chiropractic (9)	(R) Massage and sham manipulation (10)	Group (I) significantly better improvement on 10 cm VAS after 2 wk: 2.3 (I) vs. 0.6 (R)
Arkuszewski[7]	(I) Lewit (50)	(R) Bed rest, analgesics, and massage (50)	Mean (SD) pain intensity (4-point scale) posttreatment and after 6 mo (I) 0.6 (0.5), 0.7 (0.6) vs. (R) 1.0 (0.4), 1.0 (0.5); (I) significantly more improved
Postacchini[127]	(I) Chiropractic manipulation (87)	(R1) Physiotherapy: light massage, analgesic currents, and diathermy, daily for 3 wk (78) (R2) Diclofenac "full dosage," 15–20 days (81) (R3) Low back school (50) (R4) Antiedema gel (73)	Mean improvement on combined pain, disability, and spinal mobility score after 3 wk, 2 and 6 mo in subgroup with chronic pain (I) 2.2, 2.6, 4.3, (R1) 3.9, 4.2, 6.0, (R2) 2.6, 2.2, 4.0, (R3) 0.5, 4.6, 8.9, (R4) 0.7, 1.2, 2.0; (I) not significantly better

Table 20. Details of Randomized Controlled Trials on the Effectiveness of Back Schools for Chronic Low Back Pain

Reference	Back School (no. of patients)	Reference Treatment (no. of patients)	Results
Harkapaa[59,60,110,111]	(I1) Inpatient group: 3-wk rehabilitation period in groups of 6–8 patients: modified Swedish back school (4 sessions), 15 sessions back exercises, 9 sessions relaxation exercises, supervised by physiotherapist; heat or electrotherapy and massage and session with physiologist and physician; refresher course 2 wk after 1.5 yr (156) (I2) Outpatient group: 15 sessions during a 2-mo period, twice a week in groups of 6–8 patients: modified Swedish back school (4 sessions), 15 sessions back exercises, 9 sessions relaxation exercises, supervised by physiotherapist and session with physiologist and physician; refresher course 8 sessions after 1.5 yr (150)	(R) no systematic treatment; written and oral instructions on back exercises and ergonomics (153)	Changes in pain index and disability index after 3 mo follow-up: significantly greater reduction in (I1) and (I2) than in (R) (data in graphs and by ANOVA); at 2.5 yr follow-up no clear differences

Reference	Back School (no. of patients)	Reference Treatment (no. of patients)	Results
Hurri[69,70,73]	(I) Modified Swedish back school: 60 min education and exercise session, 6 times in 3 wk; refresher course 2 × 60 min after 6 mo; supervised by physiotherapist; 11 patients per group (95)	(R) Instruction material of the back school in written form; no actual treatment, but free to use health care services (93)	VAS, Pain Index, and Oswestry's Index after 6 mo follow-up (I) significantly better than (R); after 12 mo no differences (data in graphs)
Linton[96]	(I) 5-wk period in a back clinic; 8 hr/day mostly in groups of 6 patients; exercise activities (walking, swimming, jogging, cycling) 4 hr/day; ergonomic education, individual physical therapy programs, behavior therapy techniques (36)	(R) Waiting list control: no additional active treatment (30)	Pain intensity (VAS) significantly better in (I) than (R) after 6 wk and 6 mo (data in graphs and by ANCOVA for repeated measures); other outcome measures (fatigue, anxiety, sleep quality) similar results
Lankhorst[88]	(I) Swedish back school: 4 sessions of 45 min in the course of 2 wk (anatomy and causes of LBP, function muscles and posture, ergonomics, advice on physical activity) (21)	(R) 4 sessions with detuned shortwave applications in a period of 2 wk (22)	Mean pain on 10-point scale after the intervention and after 3, 6, and 12 mo; (I) 6.0, 5.9, 6.2, 5.6 (R) 6.8, 6.5, 5.8, 6.5; no significant differences (including functional capacity)
Keijsers[75]	(I) Maastricht back school: education and skills program in group setting (10–12 patients): 7 lessons of 2.5 hr, refresher lesson after 6 mo; including postural education, exercises, information on psychological factors (−)	(R) Waiting list control group (−)	Mean pain (VAS) after 2 and 6 mo (I) 5.4, 5.4 vs. (R) 5.2, 4.6; no significant differences including functional status
Donchin[37]	(I) 4 90 min sessions during a 2-wk period plus a fifth session after 2 mo; 10–12 patients per group supervised by a physiotherapist (education and exercises for back and abdominal muscles) (46)	(R1) Calisthenics in 45 min sessions biweekly for 3 mo in groups of 10–12 patients (flexion and strengthening exercises) (46) (R2) Control group (were promised the most effective program in the future) (50)	Incidence of LBP episodes (mean of painful months during 12 mo follow-up): (I) 7.3 (R1) 4.5 (R2) 7.4; (R1) significantly better than (I) and (R2)
Postacchini[127]	(I) Based on Canadian Back Education Unit: four 1-hr sessions in a 1-wk period (including muscle exercises) (50)	(R1) Manipulation daily first week, then twice a week for 6 wk (52) (R2) NSAIDs (15–20 days) (47) (R3) Physiotherapy: light massage, analgesic current, and diathermy daily for 3 wk (47) (R4) Antiedema gel twice a day for 2 wk (43)	Mean improvement on combined pain, disability, and spinal mobility scores after 3 wk, 2 mo, and 6 mo; (I) 0.5, 4.6, 8.9 (R1) 2.2, 2.6, 4.3 (R2) 2.6, 2.2, 4.0 (R3) 3.9, 4.2, 6.0 (R4) 0.7, 1.2, 2.0; back school significantly better after 2 and 6 mo
Herzog[64]	(I) Back school program (including instruction on how to move and stretching postural exercises) supervised by physiotherapist: 10 sessions in a 4-wk period (13)	(R) Manipulation: 10 treatment sessions in 4 wk (16)	Mean pain score after 4 wk significantly lower in (I) vs. (R) (data in graphs); (R) significantly better in restoring gait symmetry
Klaber[77]	(I) Swedish back school: 3 sessions containing education on anatomy and body mechanics, semi-Fowler position, ergonomic counseling, and exercises aiming at strengthening the abdominal muscles (40)	(R) Exercises only [same as in group (I)] (38)	Change in mean pain and functional disability scores after 8 and 16 wk significantly larger in (I) vs. (R) (data in graphs)
Keijsers[74]	(I) Maastricht back school: education and skills program in group setting (10–12 patients): 7 lessons of 2.5 hr and refresher lesson after 8 wk; including postural education, exercises, information on psychological factors (20)	(R) Waiting list control group (20)	VAS for pain after the program: (I) 28.9 (R) 31.9; no significant differences for most of the outcome measures, including daily activities

NSAIDs = nonsteroidal anti-inflammatory drugs.

Table 21. Details of Randomized Controlled Trials on the Effectiveness of Electromyogram (EMG) Biofeedback Therapy for Chronic Low Back Pain

Reference	Index Treatment (no. of patients)	Reference Treatment (no. of patients)	Results
Asfour[8]	(I) Rehabilitation program + progressive extension training in lying position with auditory and visual EMG biofeedback (8 sessions) (15)	(R) Rehabilitation program (15)	Mean (SD) pain intensity pretreatment and posttreatment (2 wk) (I) 6.1 (2.9), 4.7 (2.6) (R) 5.6 (2.4), 5.6 (2.4); not significant; ROM not different between groups; (I) significantly more increase in strength

Reference	Index Treatment (no. of patients)	Reference Treatment (no. of patients)	Results
Bush[24]	(I) Auditory EMG biofeedback training in sitting position until decrease and increase of 2 μV without feedback was reached with max 8 sessions (22)	(R1) Placebo feedback of back temperature (22) (R2) Waiting list control (22)	No significant differences in pain intensity, functional status, or psychosocial status
Nouwen[120]	(I) Auditory and visual EMG biofeedback training in standing position, 15 sessions in 3 wk (10)	(R) Waiting list control, no treatment (10)	Mean (SD) pain level (duration × intensity) pre- and posttreatment (I) 15.8 (9.4), 14.3 (8.6) vs. (R) 18.4 (11.8), 19.1 (15.6); not significant
Stuckey[142]	(I) Relaxation training: progressive relaxation, breathing techniques, autogenic training, visual imagery; 8 sessions of 45 min (8)	(R1) EMG biofeedback training; 8 sessions of 45 min (8) (R2) Placebo EMG: no feedback, no relaxation instructions; 8 sessions of 45 min (8)	Mean scores of pain intensity during function test (range 0–100) at first and last treatment session (I) 36.8, 28.0, (R1) 26.2, 31.6, (R2) 42.4, 44.4 and ADL (range 1–7) (I) 2.4, 2.9, (R1) 2.6, 2.5, (R2) 2.2, 2.4; (I) significantly more improved on pain intensity than (R1) and (R2), and significantly more improved on ADL than (R1)
Donaldson[36]	(I) Progressive relaxation training (Lehrer & Woolfolk), 10 35-min sessions (12)	(R1) Single motor unit biofeedback training (Johnson, Mulder), 10 35-min sessions (12) (R2) Education on anatomy, exercise, depression, stress; 10 35-min sessions (12)	Mean scores on McGill Pain Questionnaire (MPQ) and pain intensity (VAS) pretreatment (I) 31.08, 2.51, (R1) 28.75, 2.23, (R2) 34.50, 3.48, posttreatment (I) 27.67, 1.90, (R1) 16.08, 1.26, (R2) 28.58 2.47 and after 3 mo (I) 32.33, 1.78, (R1) 15.33, 0.72, (R2) 20.08, 0.87; (R1) significantly more improved after 3 mo than (I); no significant differences on pain intensity between groups

ROM = range of motion; ADL = activities of daily living.

Table 22. Details of Randomized Controlled Trials on the Effectiveness of Exercise Therapy for Chronic Low Back Pain

Reference	Exercise Regimen (no. of patients)	Reference Treatment (no. of patients)	Results
Deyo[34]	(I1) Stretching exercises and TENS (34) (I2)Stretching exercises and sham TENS (29)	(R1) TENS (31) (R2) Sham TENS (31)	Mean improvement pain (VAS 0–100%) and activity (VAS 0–100%) after 4 and 12 wk; (I1) and (I2) 52%, 48%, (R1) and (R2) 37%, 41%; exercise significantly better
Hansen[58]	(I) Intensive dynamic back muscle training (60)	(R1) Physical therapy: manual traction, hot packs, massage and flexibility, coordination and slowly progressive back and abdominal muscle exercises (59) (R2) Placebo control: semihot packs and light traction (61)	No significant differences in pain level (10-point scale) between groups posttreatment and after 1, 6, and 12 mo; overall treatment effect (10-point scale) of (I) and (R1) significantly higher at all evaluations than (R2); no significant changes over time
Manniche[100,101]	(I1) Intensive back extensor (27) (I2) Mile isometric exercises/massage/hot compress (32) (I3) Mild back extensor (31)		Median improvement in combined pain, disability, physical impairment index (0–100 points) after 3 and 9 mo; (I1) 14.7, 15.0, (I2) 2.0, 5.5, (I3) 5.7, 7.0; (I1) significantly better than (I2) and (I3)
Elnaggar[39]	(I1) McKenzie extension (28) (I2) Williams flexion (28)		Mean (SD) scores on McGill Pain Questionnaire (range 0–78) pretreatment and posttreatment: (I1) 15.9 (7.8) and 10.6 (8.6) vs. (I2) 14.1 (9.8) and 8.9 (9.4); no significant difference
Lidström[92]	(I1) Isometric strengthening and pelvic traction (20) (I2) Mobilizing/strengthening, hot packs, and massage (21)	(R) Hot packs and rest (21)	No. of patients with noticeable improvement after 4 wk; (I1) 17, (I2) 9 and (R) 12; patients in (I1) significantly better than (I2) and (R)
Manniche[102]	(I1) Intensive dynamic exercises plus hyperextension (31) (I2) Intensive dynamic exercises (31)		Overall improvement posttreatment and after 3 and 12 mo not significantly different in (I1) and (I2); improvement on low back pain rating scale (0–100) posttreatment and after 3 and 12 mo in (I1) 10, 8, 3 vs. (I2) 7, 1, 0; significant at 3 mo
Lindström[94,95]	(I) Individual, submaximal, gradually increased exercise program: endurance and strength training, lifting, walking, jogging, swimming, fitness (51)	(R) Traditional care (52)	Proportion of patients returned to work within 6 wk or 12 wk after randomization: (I) 59%, 80% vs. (R) 40%, 58%; significant; mean (SD) duration of sick-leave due to LBP during second follow-up year: (I) 12.1 (18.4) wk vs. (R) 19.6 (20.7) wk; significant; no differences in functional status (whole body mobility) after 1 yr

Reference	Exercise Regimen (no. of patients)	Reference Treatment (no. of patients)	Results
Johanssen[72]	(I1) Dynamic back, neck, abdominal endurance exercises/stretching (20) (I2) Coordination/balance exercises (20)		Median pain score (scale 0–8) pretreatment and after 3 and 6 mo (I1) 6, 3, 4 vs. (I2) 6, 5, 4; not significant; median disability score (scale 0–12) (I1) 6, 2, 1 vs. (I2) 5, 3, 2; not significant
Turner[151]	(I1) Aerobic exercises (24) (I2) Aerobic exercises and operant conditioning behavioral therapy (24)	(R1) Operant conditioning behavioral therapy (25) (R2) Waiting list control group (23)	Mean scores on McGill Pain Questionnaire and SIP pretreatment (I1) 19.42, 8.42, (I2) 25.54, 8.50, (R1) 20.96, 7.90 and (R2) 21.17, 6.24 and post-treatment (I1) 17.52, 5.49, (I2) 12.41, 4.59, (R1) 17.71, 4.72 and (R2) 20.95, 5.37; (I2) significantly more improved than (I1) and (R2); no significant differences between (I1), (I2) and (R1) after 6 and 12 mo
Kendall[76]	(I1) Isometric flexion (14) (I2) Mobilization (14) (I3) Extension (14)		No. of patients symptom-free or improved after 1 and 3 mo (I1) 13, 11, (I2) 11, 8, (I3) 7, 6; (I1) significantly better than (I2) and (I3)
Risch[130]	(I) Dynamic extension exercise program (31)	(R) Waiting list control group (23)	Mean (SD) pain score pre- and posttreatment (I) 3.4 (1.6), 2.9 (1.7) vs. (R) 3.7 (1.6), 4.1 (1.5); significant; mean (SD) physical disability score (SIP) (I) 9.1 (9.3), 7.7 (9.4) vs. (R) 15.2 (10.4), 19.3 (15.6); significant
Martin[104]	(I1) Mobilizing abdominal and back muscles (12) (I2) Isometric abdominal and pelvic floor muscles (12)	(R) Detuned ultrasound and detuned shortwave diathermy (12)	Change in pain intensity (5-point scale) after 5 wk; (I1) decrease, (I2) increase, (R) decrease; no significant differences in physiological and clinical measures
Buswell[26]	(I1) Flexion program (25) (I2) Extension program (25)		Similar improvement of pain and function after treatment for (I1) and (I2); data not given
Sachs[134]	(I1) Rehabilitation program: stretching/strengthening/cardiovascular conditioning exercises plus exercises on B-200 isostation (14)	(R) Rehabilitation program (16)	No significant difference in range of motion after 3 wk treatment period
Frost[47]	(I) Fitness program and back school education (36)	(R) Back school education (35)	Mean (SD) scores on functional status (Oswestry) and pain (0–100 scale) pretreatment (I) 23.6 (9.7), 20.9 (12.3) vs. (R) 23.6 (12.3), 25.6 (17.9) and post-treatment (I) 17.6 (10.9), 12.1 (9.9) vs. (R) 21.7 (13.6), 22.1 (20.1); (I) significantly more improved than (R); after 6 mo (I) significantly more improved functional status than (R)
White[159]	(I1) Mild static trunk and shortwave diathermy (76) (I2) Vigorous flexion and extension (72)		Proportion of patients showing improvement after treatment (max 7 wk) 38% (I1) vs. 35% (I2); not significant

TENS = transcutaneous electrical nerve stimulation.

Table 23. Details of Randomized Controlled Trials on the Effectiveness of Traction and Orthoses for Chronic Low Back Pain

Reference	Index Treatment (no. of patients)	Reference Treatment (no. of patients)	Results
Traction			
Heijden[61]	(I) Continuous motorized traction, 30–50% of body weight, 20 min, 3 times per week, 4 wk (13)	(R) Continuous motorized traction, 0–25% of body weight, 20 min, 3 times per week, 4 wk (12)	Median improvement of pain and functional status after 5 wk (I) 14, 2 vs. (R) 16, 1 and after 9 wk (I) 14, 2 vs. (R) 4, 2; no. of patients completely recovered or much improved after 5 and 9 wk in (I) 7/13, 5/13 vs. (R) 4/12, 3/12; no significant differences
Orthoses			
Million[115]	(I) Corset with lumbar support for 8 wk (9)	(R) Corset without lumbar support for 8 wk (10)	Overall subjective improvement index: (I) highly significant improvement (R) no change; overall objective improvement index: (I) and (R) improvement over the study period but no difference between groups

Table 24. Details of Randomized Controlled Trials on the Effectiveness of Behavior Therapy for Chronic Low Back Pain

Reference	Index Treatment (no. of patients)	Reference Treatment (no. of patients)	Results
Lindström[94,95]	(I) Individual, submaximal, gradually increased exercise program with an operant conditioning behavioral approach (Fordyce) (51)	(R) Traditional care (52)	Proportion of patients returned to work within 6 wk or 12 wk after randomization: (I) 59%, 80% vs. (R) 40%, 58%; significant; mean (SD) duration of sick-leave due to LBP during the second follow-up year: (I) 12.1 (18.4) wk vs. (R) 19.6 (20.7) wk; no differences in functional status after 1 yr

Reference	Index Treatment (no. of patients)	Reference Treatment (no. of patients)	Results
Turner[150]	(I1) Aerobic exercises and operant conditioning (Fordyce); 2 hr/wk, 8 wk (30) (I2) Cognitive behavioral approach; systematic progressive muscle relaxation (Bernstein & Borkovec) and imagery; 2 hr/wk, 8 wk (26)	(R) Waiting list control group (25)	Mean (SD) scores on McGill Pain Questionnaire and SIP pretreatment, posttreatment, and after 6 and 12 mo; (I1) 23.07 (12.37), 18.50 (12.43), 19.57 (15.31), 15.07 (11.62) vs. (I2) 18.30 (10.43), 15.92 (11.63), 12.70 (12.75), 10.80 (6.38); not significant; (I1) significantly better posttreatment than (R) on pain and physical and psychosocial functioning
Nicholas[119]	(I) Cognitive behavioral approach, including progressive muscle relaxation training (Bernstein & Borkovec), and physiotherapy; one 2 hr and one 1.5 hr session/wk, 5 wk (10)	(R) Physiotherapy: information, exercises, and handouts (one 2 hr and one 1.5 hr session/wk/5 wk) and attention (5 sessions) (10)	Mean (SD) scores of pain intensity (6-point nominal scale) and functional status (SIP) pretreatment, posttreatment, and after 6 mo; (I) 3.13 (0.88), 3.07 (0.79), 2.89 (0.64) and 30.87 (12.17), 18.81 (10.97), 18.30 (11.18) vs. (R) 2.84 (0.85), 2.72 (0.77), 2.75 (1.11) and 32.10 (13.45), 26.08 (16.40), 25.31 (14.34); not significant; (I) significantly better posttreatment than (R) on coping strategies, pain self-efficacy, and medication use; after 6 mo (I) significantly better coping strategies
Nicholas[118]	(I1) Behavioral treatment (operant conditioning Fordyce) and physiotherapy; one 2 hr and one 1.5 hr session/wk/5 wk (10) (I2) Behavioral treatment and physiotherapy and progressive muscle relaxation training; one 2 hr and one 1.5 hr session/wk/5 wk (9) (I3) Cognitive treatment (coping strategies) and physiotherapy; one 2 hr and one 1.5 hr session/wk/5 wk (10) (I4) Cognitive treatment and physiotherapy and progressive muscle relaxation training; one 2 hr and one 1.5 hr session/wk/5 wk (8)	(R1) Physiotherapy: information, exercises and handouts (one 2 hr and one 1.5 hr session/wk/5 wk) (11) (R2) Physiotherapy (one 2 hr and one 1.5 hr session/wk/5 wk) and attention (5 sessions) (10)	Posttreatment (I1), (I2), (I3) and (I4) significantly more improved on pain intensity (6-point nominal scale), self-rated functional impairment (SIP), and pain beliefs than (R1) and (R2), but no significant differences after 6 and 12 mo; (I1) and (I2) significantly more improved posttreatment on self-rated SIP than (I3) and (I4); no other differences between index treatments after 6 and 12 mo on any of the outcome measures
Turner[147]	(I1) Progressive muscle relaxation training (Bernstein & Borkovec) (14 posttreatment; 18 follow-up) (I2) Cognitive behavioral therapy: relaxation, coping, imagery (13 posttreatment; 16 follow-up)	(R) Waiting list control group (9)	Mean (SD) score on self-rated functional impairment (SIP) and pain (VAS) pretreatment (I1) 14.6 (8.2), 57.9 (21.6), (I2) 18.6 (7.9), 55.2 (24.8), (R) 20.2 (11.1), 54.0 (32.0) and posttreatment (I1) 9.1 (8.3), 42.3 (20.2), (I2) 10.2 (6.9), 36.5 (22.7) and (R) 20.2 (8.2), 77.0 (21.6); (I1) and (I2) significantly better posttreatment than (R); pain score (I1) after 1 mo significantly better than (I2), no other differences between (I1) and (I2) posttreatment, after 1 mo and 1.5 yr on pain, depression, and functional status
Turner[149]	(I1) Behavioral therapy: operant conditioning (Fordyce); 2 hr/wk, 8 wk (25) (I2) Behavioral therapy, 2 hr/wk, 8 wk, and aerobic exercise, 10–20 min, 5 times/wk, 8 wk (24)	(R1) Aerobic exercise 10–20 min, 5 times/wk, 8 wk (24) (R2) Waiting list control group (23)	Mean scores on McGill Pain Questionnaire, SIP, and depression pretreatment (I1) 20.96, 7.90, 10.40, (I2) 25.54, 8.50, 12.38, (R1) 19.42, 8.42, 11.95 and (R2) 21.17, 6.24, 10.48 and posttreatment (I1) 17.71, 4.72, 8.08, (I2) 12.41, 4.59, 7.31, (R1) 17.52, 5.49, 7.38 and (R2) 20.95, 5.37, 7.03; (I2) significantly more improved than (R1) and (R2); no significant differences after 6 and 12 mo between (I1), (I2), and (R1)
Turner[150]	(I1) Progressive muscle relaxation training (Bernstein & Borkovec) and imagery (24) (I2) Cognitive therapy (Beck) (23) (I3) Cognitive therapy and relaxation training (25)	(R) Waiting list control group (30)	Mean (SD) pain score (VAS) pretreatment vs. posttreatment (I1) 51.29 (21.68) vs. 37.88 (20.07), (I2) 56.91 (18.47) vs. 36.88 (20.45), (I3) 60.68 (22.04) vs. 44.33 (28.45) and (R) 50.07 (21.14) vs. 48.06 (20.97) (I1), (I2), and (I3) significantly more improved than (R); no significant differences between (I1), (I2), and (I3) posttreatment and after 6 and 12 mo on pain, global measure of improvement, or functional status (SIP)
Altmaier[4]	(I) Standard rehabilitation program and operant conditioning and relaxation training and biofeedback and cognitive behavioral coping skills (24)	(R) Standard inpatient rehabilitation program: physical therapy, aerobic exercises, education, vocational rehabilitation; 3 wk (21)	Mean scores on McGill Pain Questionnaire pretreatment, posttreatment, and after 6 mo (I) 24.24, 23.76, and 22.66 vs. (R) 20.33, 18.05, and 18.19; no significant differences on any outcome measures
Stuckey[142]	(I) Relaxation training: progressive relaxation, breathing techniques, autogenic training, visual imagery; 8 sessions of 45 min (8)	(R1) EMG biofeedback training; 8 sessions of 45 min (8) (R2) Placebo EMG: no feedback, no relaxation instructions; 8 sessions of 45 min (8)	Mean scores of pain intensity during function test (range 0–100) at first and last treatment session (I) 36.8, 28.0, (R1) 26.2, 31.6, (R2) 42.4, 44.4 and ADL (range 1–7) (I) 2.4, 2.9, (R1) 2.6, 2.5, (R2) 2.2, 2.4. (I) significantly more improved on pain intensity than (R1) and (R2), and significantly more improved on ADL than (R1)
McCauley[109]	(I) Progressive muscle relaxation training (Bernstein & Borkovec) and differential relaxation; 50 min/wk, 8 wk (8)	(R) Self-hypnosis (Barber) and hypnoanalgesic techniques; 50 min/wk, 8 wk (9)	Mean scores on pain (VAS) pretreatment, posttreatment, and after 3 mo (I) 56.9, 39.1, 35.9 vs. (R) 63.1, 43.6, 42.2; no significant differences between groups on pain or depression

Reference	Index Treatment (no. of patients)	Reference Treatment (no. of patients)	Results
Donaldson[36]	(I) Progressive relaxation training (Lehrer & Woolfolk), 10 35-min sessions (12)	(R1) Single motor unit biofeedback training (Johnson, Mulder), 10 35-min sessions (12) (R2) Education on anatomy, exercise depression, stress, 10 35-min sessions (12)	Mean scores on McGill Pain Questionnaire (MPQ) and pain intensity (VAS) pretreatment (I) 31.08, 2.51, (R1) 28.75, 2.23, (R2) 34.50, 3.48, posttreatment (I) 27.67, 1.90, (R1) 16.08, 1.26, (R2) 28.58, 2.47 and after 3 mo (I) 32.33, 1.78, (R1) 15.33, 0.72, (R2) 20.08, 0.87; (R1) significantly more improved after 3 mo than (I); no significant differences on pain intensity between groups

ADL = activities of daily living.

Table 25. Details of Randomized Controlled Trials on the Effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS)/Acupuncture for Chronic Low Back Pain

Reference	TENS/Acupuncture (no. of patients)	Reference Treatment(s) (no. of patients)	Results
TENS			
Deyo[34]	(I) TENS 3 times daily 45 min; high frequency (80–100 pulses per sec, amplitude 30) 2 wk plus low frequency (2–4 pulses per sec, amplitude 100) 2 wk or high frequency 4 wk (65)	(R) Placebo TENS 4 wk (60)	Difference (95% CI) between (I) and (R) posttreatment: functional status (SIP) −0.5 (−2.2, 1.3), pain (100 mm VAS) −2.3 (−9.6, 4.9), Schober test (cm) 0.13 (−0.24, 0.50); no significant differences on any of the outcome measures
Marchand[103]	(I) TENS high frequency (125 μs pulses, low intensity, 30 min, twice a week, 10 wk) (14)	(R1) Placebo TENS (12) (R2) No treatment (16)	(I) significantly more effective in pain intensity than (R1) after 1 wk, but not after 3 and 6 mo; pain unpleasantness ratings not different; data in graphs
Lehmann[90,91]	(I) TENS 250 pulses per sec, 60 Hz, subthreshold intensity, 3 wk (18)	(R1) Placebo TENS (18) (R2) Electroacupuncture 2 times per week, 2–4 Hz, 3 wk (17)	(R2) significantly more relief of peak pain posttreatment and after 6 mo and significantly more relief of average pain posttreatment and after 6 mo than (I) and (R1); no differences between (I) and (R1); data in graphs
Acupuncture			
Coan[28]	(I) Acupuncture/electroacupuncture (±10 treatments) (25)	(R) Waiting list control group (25)	Reduction in pain score (11-point scale) and ADL (4-point scale) after 10–15 wk; (I) 51%, 19% vs. (R) 2%, 0%; inadequate treatment in 11 of the 50 patients treated with acupuncture
Mendelson[112,113]	(I) Acupuncture 30 min, twice a week, 4 wk (36)	(R) Placebo acupuncture (41)	Reduction in pain score (100 mm VAS) (I) 40% vs. (R) 26% after 4 wk; not significant; crossover: reduction in pain score (I) now placebo 40% vs. (R) now acupuncture 19%; significant; overall mean percentage decrease in pain score 26.1 for acupuncture and 21.8 for placebo, not significant
MacDonald[97]	(I) Acupuncture/electroacupuncture 5–20 min, once a week, 7 wk (8)	(R) Placebo acupuncture (9)	Mean percentage reduction posttreatment in pain score and ADL: (I) 57.1, 52.0 vs. (R) 22.7, 5.83. ADL significant
Edelist[38]	(I) Manual acupuncture plus electroacupuncture 3–10 Hz, 30 min, 3 treatments (15)	(R) Placebo acupuncture (15)	No. of patients improved posttreatment on pain and spinal mobility (I) 7, 7 vs. (R) 6, 6; not significant
Lehmann[90,91]	(I) Electroacupuncture 2 times per week, 2–4 Hz, 3 wk (17)	(R1) Placebo TENS (18) (R2) TENS 250 pulses per sec, 60 Hz, subthreshold intensity, 3 wk (18)	(I) Significantly more relief of peak pain posttreatment and after 6 mo and significantly more relief of average pain posttreatment and after 6 mo than (R2) and (R1); no differences between (R2) and (R1); data in graphs
Gunn[55]	(I) Rehabilitation program plus acupuncture 1–2 times per week, 10 treatments max (29)	(R) Rehabilitation program (27)	No. of patients with good or total improvement at discharge and after 12 wk in (I) 18, 17 vs. (R) 4, 4; significant

CI = confidence interval; ADL = activities of daily living.